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A STUDY OF COMMONALITIES AMONG SELECTED ARTISTS AND SCIENTISTS

by

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A THESIS
SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH
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FACULTY OF GRADUATE STUDIES AND RESEARCH

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research, for acceptance, a thesis entitled A Study of Commonalities Among Selected Artists and Scientists submitted by Pamela Hall-Byrne in partial fulfilment of the requirements for the degree of Master of Education

L.O. Stewart
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Date June 29, 1978

TO MY PARENTS MARIBETH AND JOHN HALL.

ABSTRACT

A major characteristic of the Western intellectual tradition has been the fragmentation and classification of human knowledge and experience. Deeply embedded in this tradition is the tendency to polarize and dichotomize classification of knowledge and to define ideas, disciplines and even groups of people, through difference and opposition. The components of human experience and knowledge which are labelled Art and Science have long been polarized in such a manner and have come to represent, at least on the level of conventional wisdom, the opposite and irreconcilable ends of an assumed dichotomy. Included in the traditional assumptions which oppose Art and Science are the stereotypical definitions of the Artist and the Scientist as representative of the romantic versus the classical approach to life. Consequently, traditional acceptance of the supposed dichotomous relationship between Art and Science has opposed not only the two fields, but also the individuals creating within them.

This study attempted to illuminate the limitations of the traditional Art-Science dichotomy as an heuristic pattern of thought through an examination of commonalities between selected Artists and Scientists. Ten individuals were selected from history as representative of various historical periods and specializations within the Visual Arts and the Sciences. All of the individuals were highly creative, and innovative if not revolutionary, and all had contributed significantly to their respective disciplines. Johannes Kepler, Charles Darwin, Hermann von

Helmholtz, Niels Bohr and Albert Einstein comprised the Scientist sample and Leon Battista Alberti, Eugene Delacroix, William Morris, Paul Cezanne and Pablo Picasso were the members of the Artist sample. Each individual was described morphogenically, utilizing a phenomenological approach to personality, and each group displayed internal commonalities. Commonalities were displayed between the groups, by all individuals, in the realms of world view, modes of thought, and creative behaviour. Few commonalities were displayed in areas of social and personal interactions, and social and political consciousness. It appeared however, that differences in these two areas were individual rather than group derived.

It was concluded that the traditional stereotypical definitions of Artist and Scientist were highly misleading and restrictive. In addition, in the face of the common characteristics shared by the groups, the assumptions regarding Art and Science as highly differentiated endeavours were called into question. It appeared that such a dichotomous view of the two fields was exceedingly limited, narrow and inhibiting and could serve only poorly as a framework within which to make judgements or promote meaningful inquiry.

A more inclusive, synergetic view of Art and Science was seen to be a necessary pre-requisite for understanding of both disciplines and those individuals who create within them.

ACKNOWLEDGEMENT

I am deeply indebted to the many individuals who have contributed to both the development and the completion of this study. A number of people have provided me with encouragement and support in the evolution of my thoughts on Art and Science, and for their time, energy and intelligent understanding, I am very grateful. Dr. Ron N. MacGregor and Dr. Lorne D. Stewart have been consistent in their interest, insightful in their criticism and patient, good-humoured and open-minded in their dealings with me. I have learned a great deal from both and am pleased to have had the opportunity of working with two men who are so truly, teachers.

I wish also to note my obligation to John Vetterlein, who long ago planted an interest in science in a young art student, and whose steady and stimulating contribution to the growth of my understanding has been a rich and valued part of my life.

Without the friendship and emotional support provided by Joan Borsa, Susan Burghardt and Georgina Karklin, the completion of this study would have been a long and painful process. I thank them all for "being there."

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CHAPTER ONE

THE PROBLEM

INTRODUCTION

For a number of reasons modern man seems to have learned to categorize and delineate knowledge into a number of self-contained and seemingly independent components, with the result that our culture exhibits a strong tendency to fragment and polarize fields of knowledge. Art and Science are perhaps, two of the most obviously polarized disciplines in the Western hierarchy of knowledge, and this study is an attempt to determine the degree of validity within the traditional assumption that they are exclusive and inherently opposed endeavours.

The major portion of this study is directed towards an examination of the artists and the scientists and the processes, characteristics and thinking styles employed by them in their work as creators. Through this examination, it is hoped that discovery and delineation of common traits will provide insight into the relevance and validity of the traditional Western assumption of difference between them.

In this chapter, the contextual background to the problem is described, the problem itself is stated, the specific purpose of the study is delineated and relevant terms are defined. Following these sections is an indication of the significance of the study, an outline of the organization of the report, and an examination of the limitations and assumptions which apply in the area of the conceptual and methodological components of the study.

BACKGROUND TO THE PROBLEM

Within the roots and foundations of Western thought, one can find both the sources and symptoms of the traditional dialectical tension between what we now call Art and Science. Historically, one may trace this tension even further back in time than when Art was merely "craft," and Science, merely "alchemy." It shares in its origins and in some of its manifestations, with the great philosophical dichotomies of Western thought which find form in questions concerning "mind versus body," "reason versus emotion," and "logic versus intuition." It would seem, in fact, that Western philosophy in general has defined and explored human knowledge through the concept of opposing polarities and dualistic classification, from the very beginning of its development and growth.

The traditional polarization of Art and Science, in particular, is symptomatic of this tendency, and can itself, be traced as far back as the writings of Plato and Aristotle. Since that time, it has become perhaps one of the most taken-for-granted assumptions of the Modern Western world. What was then, for the Greeks, a philosophical theory of man, reality and knowledge, has become in the minds of many a praxiological reality which is manifested throughout the matrix of our culture in areas as diverse as education, literature and government funding. What began as merely an intellectual dichotomy, has grown to an assumed definitional split of great proportion and has become, in the Kuhnian sense, a paradigm for Art and Science (Kuhn, 1970), with Art at one pole and Science at the opposite one. Even in the face of such a well entrenched traditional dichotomy, however, it must be remembered that it remains an assumed polarity and may be real only within the structure of human belief. It rests, however powerfully, on conceived difference, as viewed and assumed by Western thinkers, and not necessarily upon objective reality. It is one of our greatest cultural stereotypes, and like all stereotypes, may be based more on exaggeration than on fact.

The polarization of knowledge components is not as symptomatic of traditional Eastern thought as it would seem to be of the West. Historically, Eastern philosophy, as typified by Taoism, Indian Buddhism and Zen, has been less delineated into defined disciplines, less ordered into exclusive hierarchical conceptual structures and less tightly classified into independent categories. Eastern thought, therefore, is distinctly lacking the dichotomized approach to knowledge which is so prevalent in Western tradition. There seems, rather, in the writing of Eastern thinkers, a quite different view of reality and of human knowledge, which is inclusive where the West is exclusive. The East tends to define through sameness and commonality where the West defines through difference. The East views knowledge as open and intrinsically related, where the West tends towards closure and isolation of knowledge. For a Taoist, the Western polarization of Art and Science would be incomprehensible, and would seem largely a restricted view of knowledge and experience. Eastern thought, then, traditionally avoiding rigid categorization of knowledge, is free of a view which polarizes its component parts, such as Art and Science.

Certainly the Zen and Taoist masters of the East are not alone in seeking a more holistic and less fragmented view of human knowledge. Neither are they alone in their tendency to define through commonality rather than difference, and they are joined by those who take exception to the Western tradition of fragmented and tightly classified knowledge. Many of these are Western writers who do not accept the traditional opposition of Art and Science, and they bring into question the validity and relevance that such a polarized view of knowledge may have in best advancing inquiry. In education, in the Arts and in the Sciences, there are some, though in a minority, who seek to move beyond the traditional schism to a more inclusive and holistic approach to knowledge, and who seek commonality between Art and Science, because they find the assumed dichotomy too restrictive.

Education has proved both greatly influenced by the traditional divorce of Art and Science and at the same time has been supremely effective in maintaining it. Yet even there, where the approach to human knowledge and experience is based almost totally on fragmentation, there has been an expressed concern on the part of many writers, Holt, Kozol and Goodman being but a few, that the traditionally schismatic approach to knowledge is untenable and perhaps even unhealthy. Though these voices and others like them, have been at times quite loud and have drawn more than scattered support, the school has maintained, for the most part, its traditional stance. It continues to separate, polarize and fragment its presentation and treatment of knowledge. In the case of Art and Science, one can find the traditional dichotomy in its most powerful manifestation, and it would be difficult to find a more tightly classified, closed and insular treatment than that which the school employs in dealing with these two products of man's creative endeavour.

The growth and power of specialization in the 20th century has, in many ways, encouraged educators to reinforce the traditional Art-Science separation, and because it manifests itself at all levels of the educational hierarchy it cannot be lightly set aside. The tendency to specialize has consequences which reach far beyond the mere classification of knowledge and its selection for educational use. As Basil Bernstein (1971) points out in one context, and C.P. Snow (1959) in another, the consequences of specialization reach into areas of methodology, communication, administration, perception and ultimately into the choice and defense of values which influence not only Art and Science, but which also dictate definitions of knowledge itself and validate or reject means and modes of attaining it. The traditional opposition of Art and Science, strengthened by the growth of specialization, may be clearly seen as related to, if not actually influencing, accepted notions of "what can be known" and "what should be known." Perhaps even more important, the assumed opposition relates to and influences definitions of "how to know" and assumptions concerning the means by which specific knowledge is to be acquired. The most predominantly acceptable mode of knowing in Western culture is that of the empiricist, the scientist and the logician, and assumes the exclusive merit of linear, vertical and convergent modes of thinking.

The Western assumptions concerning means and modes of knowing are easily contrasted by counter-active beliefs predominant in Eastern teaching. Because Eastern tradition has refrained from defining knowledge in the linear abstractions of the West, it has also avoided defining ways of knowing in the Western manner of exclusively empirical, rational and linear inquiry. Ways of knowing in the East rest rather on integrative, holistic means of intuiting reality, on the peripheral, undirected, reflective and insightful aspects of mind. The West might label it a union between the rational, the intuitive or divergent and the visionary modes of knowing, though this definition would be far from complete. To an Eastern thinker, the polarization displayed in Western schools between "art knowing" (or doing, experiencing, or creating) and "science knowing" (or thinking, analysing, observing), would appear an unnecessary dissection of an act which is whole and unable to be separated.

In the field of Western scientific thought, we find some who address themselves to the particular problems of "ways of knowing," and the felt inadequacies of the traditional dichotomy between Art and Science and its encouragement of tight exclusive definitions. Though not all speak directly of the Art-Science split, writers such as Kuhn, (1970), Maslow (1969) and Koestler (1964), find the traditional polarization of reason-intuition (which certainly characterizes traditional assumptions about the modes of knowing in Art and Science), an inadequate and restrictively narrow framework within which to inquire. All have pointed out, from different angles and with different emphasis, that the traditional delineation and classification of knowledge and modes of acquiring it, is not capable of providing a sufficiently comprehensive view of knowledge in Science. They argue for a less rigidly structured, less exclusive theoretical framework within which to work. If, within the field of Science itself, there are limitations due to the traditional Western view of knowledge, then those limitations are likely to exist in the Art-Science dichotomy which is a product of the same tradition.

If the foundations of the traditional view of Art versus Science, created by the Western tendency to polarize and classify knowledge, begins to appear restrictive and fragmented when seen against other, more inclusive patterns for thought, it would seem there is an argument for advancing more comprehensive and ultimately more satisfactory alternatives.

In addition to the possible restrictions of the traditional assumption polarizing Art and Science, the power such an assumption wields in the realm of values and cultural bias provides further reason to examine it more carefully and perhaps to seek alternatives. Traditionally, the axiology of Western culture in general, and of community and school in particular, has placed Science at a higher position in the scale of values than Art. Since the launching of Sputnik and the ensuing technological explosion, the emphasis of North American education has been in the realm of Science, and on scientific modes of knowing. This emphasis, coupled with and encouraging specialization, has tended to increase the polarity (at least the conceived polarity) between Art and Science, even in the face of "Humanist" reformers in education and futurist planners concerned with such rapid, unimpeded growth in science and technology. Movements in recent years emphasizing "educating the whole child," demands for integration, concern with individual alienation and fragmentation of society, seem to have had little effect upon the polarization and fragmentation of knowledge upon which many of the current value positions are based. Evidence of continued maintenance of values entrenched in the acceptance of the traditional Art-Science dichotomy can be most easily detected in the school. If we can assume that the school is reflective of cultural values, then an examination of school curricula, of the form of timetables, of course offerings, staff allocations and of the comparative size of budgets, will disclose the staggering importance of Science and scientific modes of thought in comparison to Art and related ways of knowing.

Although the development and growth of Art education over the past three decades has certainly had some positive influence on the position of Art within educational value hierarchies, there seems little effort on the part of Art educators to examine similarities between Art and other dimensions of human knowledge and endeavour, and almost none at all attempting to relate Art and Science. The emphasis in the literature and research seems rather to be on definition through difference, as dictated by traditional assumptions concerning knowledge.

In the last decade alone, in the midst of fairly wide spread recognition of the limits of exclusive specialization, approximately two-thirds of research in American Art Education has been focussed on the field of aesthetics, (Jagodzinski, 1976) an area exclusively concerned with the visual arts. That decade was prefaced, however, with Ecker and Eisner's call for the researcher in Art education to "enquire into those ethical problems resulting from competing value orientations in both his school and society." (Ecker and Eisner, 1966 , pg. 25). They make a strong case for philosophical inquiry focussing at the critical analysis of knowledge which is significant in terms of the value problems of man. It would not be presumptuous to assume, at least some connections between the conceived polarity of the traditional view of Art and Science and the relating value differentiation between the two fields. It is possible that if the traditional dichotomy were re-examined, with an emphasis on commonality rather than difference, much of the conceived polarity might disperse, and the present value differentiation might be reviewed.

There would seem then, much to be gained from a more careful examination of the Art-Science relationship, and in so doing, in avoiding the restrictive tradition of defining by difference, by exploring common and shared elements between the fields. There would seem reason to believe that in such an examination commonalities would come to light which could contribute to the framing of a more comprehensive, inclusive synergetic view of Art and Science, than the traditional more restrictive one.

Outside of the boundaries of Art Education there has been substantial work done in the attempt to de-polarize Art and Science. In a metaphorical sense, this work has tried to build a bridge between the two fields, over the widening gap which exists definitionally between them. The majority of this work has dealt almost exclusively with the fields or disciplines themselves and for the most part approaches the problem from one of three directions.

The first of these approaches concerns itself with pointing out parallels between historical developments within both fields in a Spenglerian view of historical determinism; the second approaches bridge-building from the angle of the effects one field has on the other, as in writings dealing with the influences of technology on art; and the third stresses the comparison of common aspects or shared elements explored by both fields, as typified by the work of Kepes (1965) on structure in Art and Science. It would seem that an equally obvious place at which to seek an interface between Art and Science is in the realm where both are produced, in the human being. It is the artist and the scientist who have created Art and Science, and it should be in the act of such creation, in the act of discovering and structuring the world where common traits might best be examined if an integrated heuristic view is to be developed. Not enough has been done to delineate the human traits and characteristics of thought and action shared by the artist and the scientist in the process of exploring and creating. From such a set of common traits, drawn primarily from the individual creative process in Art and Science, a synthesis of thought and behaviour patterns might be delineated and might provide the basis for a de-polarized understanding of both fields. Such a comprehensive, inclusive view would allow greater insight into the process of creativity, independent of discipline, and might as well provide a less restrictive and less dichotomized definitional context for Art and Science.

The reader may well be led by now, to the major questions which puzzled this investigator, and with which this study is primarily concerned. Do commonalities exist between artists and scientists? What are they and are they exclusive to the creative endeavour? Can they be delineated and would they contribute to less restrictive and less dichotomized understanding of Art and Science? Can an integrated view based on commonality be developed to contribute to a holistic view of human knowledge and experience?

PROBLEM STATEMENT

In an attempt to examine the validity of the assumptions of the traditional Art-Science polarization, this study addresses itself to the following problem: do significant commonalities exist in the creative artist and scientist which might contribute to a less restrictive and less polarized view of Art and Science?

PURPOSE OF THE STUDY

The specific purpose of this study in attempting to illuminate the problem is to:

a) discover and delineate possible common characteristics of creative behaviour and thinking style in artists and scientists.

b) to select and synthesize these common elements where they exist into a synergetic and heuristic view of the Artist and Scientist, which might provide a basis for more comprehensive, less stereotyped insight into the fields of Art and Science.

c) to examine the implications of such commonalities as are discovered for the traditionally assumed dichotomy between Art and Science and its dominant educational manifestations.

SIGNIFICANCE OF THE STUDY

The discovery and delineation of common creative traits existing within the artist and the scientist has certain implications for the teacher of Art in the area of curriculum development and methodology, as well as in regards to the theoretical foundations of Art Education. Little ammunition is presently available to aid teachers in the implementation of integrated programming and methods, and no theoretical base presently exists within which to view common aspects of the artistic and scientific endeavour. Though this study merely begins to lay the foundations for commonality, it is hoped that it will at least provide an alternative framework from within which to view the educational traditions in Art and Science. The dominance of a fragmented and polarized approach to knowledge has obscured many links and interactions which may surface in this work, and the development of a less restrictive view of Art and Science will provide a structure in which man's creative processes may be more easily understood, and thus might provide insight into the possibilities of encouraging creative growth in education.

ASSUMPTIONS AND LIMITATIONS

The assumptions and limitations in this study arise primarily in the area of research design and method of approach. They will, therefore, be dealt with specifically in the chapter dealing with that aspect of the study. There are however, certain conceptual limitations and one major assumption which are of greater consequence and which are stated below.

Assumptions:

It is assumed that investigator bias in the design of the research, the selection of source material, and the analysis of data will be avoided or minimized by cross-checking with recognized authoritative sources, and by presentation of opposing opinion and possible explanations of the data.

Limitations:

The greatest conceptual limitation affecting this study is the functioning power in the literature and in the background of the investigator, of the traditional dichotomy between Art and Science. Because of its long history and established acceptance, many of the data sources take for granted the differences between the two fields, and thus the language, attitudes and premises of much of the data may be biased in favor of differences. The investigator has attempted to counteract such bias by establishing a criteria-based independent framework within which to analyse the data. This framework and the justification for it are described in detail in Chapter 3.

ORGANIZATION OF THE STUDY

Chapter One has introduced and laid the contextual background for the problem and has discussed the relevant questions to be addressed by the study. Chapter Two provides the study with its context within the field and its theoretical framework, by reviewing literature which examines Art-Science relationship and commonality. Because the study is one which cross-cuts fields, and the reader should be clearly informed of literature in various fields which has bearing on the problem and approach of this study, the review in Chapter Two will deal primarily with context and conceptual background, avoiding literature which deals with the particular methodology adopted in the research process itself. Chapter Three reviews literature relevant to the specific methodology and organization of the study, and describes the design of the research. Chapter Four presents the data on the sample of scientists and analyses it according to the criteria described in Chapter Three. Chapter Five presents the data and data analysis on the sample of artists. Chapter Six will synthesize the findings of Chapter Four and Five, and will delineate the common elements of both. Chapter Seven presents a summary of the findings, Conclusions, Implications, and Recommendations for further research.

CHAPTER TWO

REVIEW OF THE LITERATURE

INTRODUCTION

This chapter examines pertinent literature and research drawn from various fields, in order to provide the theoretical background in which the traditional polarization of Art and Science is viewed within this study. It takes as a starting point of reference the cultural stereotypes which typify Art and Science within conventional wisdom and illuminates, through the review of holistic approaches to the Art-Science relationship, the broader, more inclusive framework within which this study is situated. The particular domains of Art, Science and Education have been highly influenced by the increase of specialization as discussed in the previous chapter. The search for unifying concepts, common elements, or relationships is, necessarily, outside the scope of most specialized studies in these fields, and for this reason a good deal of the literature of particular relevance here, lies in that rather indiscriminate area where boundaries remain intangible. The common characteristic of the writers discussed in this chapter, whether they be scientists, philosophers, artists or psychologists, remains their holistic approach to normally differentiated and highly polarized aspects of human endeavour. To put it simply, then, the writers examined in this chapter, provide alternative or opposing views to the traditional polarization of Art and Science. The theoretic and epistemological position from which this study approaches the problem may be seen then within this general trend of opposition to the Art-Science dichotomy.

THE ARCHETYPAL ARTIST AND SCIENTIST: THE MISTAKEN MYTH

There is little doubt that twentieth century Western culture incorporates into its conventional wisdom a countless number of generalized archetypes and stereotyped descriptors for use in categorizing and classifying knowledge of reality. Indeed, without such patterns of generalized classification, much human learning would remain unrelated and to a very great degree, useless. There are, however, serious limitations when such an approach to knowledge and experience is applied to human behaviour and personality, and grave misconceptions often arise when human beings are consistently viewed as members of a group for which an archetype is available and generally accepted. Such has been the case of the artist and the scientist as viewed by conventional wisdom, or the "lay" public, and even by a number of specialists in both fields. In many ways, the Artist and the Scientist, in the traditional archetypal sense, have come to stand for the assumed conceptual split between Romanticism and Classicism, and have been irreconcilably alienated as representatives of two radically opposed philosophical approaches to reality.

There are those, however, to whom such a reliance on general archetypal categorizations obscures rather than clarifies the understanding of both the fields of endeavour and human beings involved in them. Ronald Brown (1977) calls attention to the cultural stereotyping of the

Scientist and argues that the view held by the "intelligent layman" of the "white-coated, completely logical thinking machine," is based on common misconceptions and remains no more than a popular fallacy. In his examination of the process of scientific discovery he points out the role of chance, of accident, of inspiration and intuition and of highly personal and emotional involvement in the process of science and argues as well that the creative process which typifies science is the same as that process in art or literature or music. (Brown, 1977)

The general stereotype of the cold, logical and objective Scientist is further contradicted by the fact that scientific innovators often make use of dreams, inspiration, intuition and sudden insights in the solving of problems or in the process of discovery. Hadamard (1945), Koestler (1964), Kuhn (1970), and Polanyi (1964) all argue that the Scientist, in the process of discovery or creation, in fact utilizes all of the personal, imaginative, non-linear, and emotional means which are so usually attached to the stereotypical Artist. Certainly, documents left by scientists themselves imply a much higher degree of emotional input, faith and intuition than the cultural archetype of Scientist would give credence to. The experiences reported by Poincare, Watt, Newton, Gauss and many others relating intuition to discovery in science cast doubt as well on the stereotyped exclusive "objectivity" and unpolluted "reason" of the Scientist. (Brown, 1977). The emotional involvement of the Scientist in his work has also been well documented and the intensity of emotive energy invested and released in the creative process may be found in most scientific innovators. Pasteur, Darwin, Kepler, Faraday, and numerous others all related incidents which might be viewed as "peak experiences" (Maslow, 1964), and their committment to their work was undoubtedly highly emotional as well as intellectual.

Maslow (1969) also called into question the traditional archetype of the scientist, described the versatility of the great scientist, of the creative and healthy scientist in the following manner. It is possible he states, for the Scientist to enjoy

> not only the beauties of precision but also the pleasures of sloppiness, casualness, and ambiguity. They are able to enjoy rationality and logic but are also able to be pleasantly crazy, wild, or emotional. They are not afraid of hunches, intuitions, or improbable ideas. It is pleasant to be sensible, but it is also pleasant to ignore common sense occasionally.
> (Maslow, 1969, pg. 31)

In addition to those writers who have provided an alternative view of the Scientist, at variance with the traditional archetype, there is evidence as well to imply that the Artist archetype is equally inadequate and replete with misconceptions. The traditional cultural view of the Bohemian artist, entirely subjective, intuitive, emotional and spontaneous in his approach to the world, devoid of an ordered, structured, rational mode of thought, is one which has gained considerable currency since the Romantic movement of the 19th century. A close examination, however, of a great number of artists immediately contradicts the general truth of such a view. In the vast body of literature written about the process of art, its principles, elements and meaning, there would be almost no writer who does not relate the structure, order, balance and often highly objective decision-making involved in the art process. (Gombrich, 1960), (Chipp, 1968) The use of symbolic, abstract and formal structures for communication is probably as common and rigourous in the visual arts as in many of the sciences.

Rudolph Arnheim argues that perception itself is a cognitive activity and that artistic activity itself is a form of reasoning, incorporating selectivity, categorization of concepts and problem solving. (Arnheim, 1969) He argues that the traditional split between vision or perception and reasoning, the archetypal descriptors for the qualities of Artist and Scientist respectively, is inadequate in dealing with the problem of perception and suggests "connections where distinctions are cherished by many." (Arnheim, 1969, intro, pg. vi)

One finds, in fact, in the examination of the work and lives of Artists such as da Vinci, della Francesca, Carravagio, Bernini, Constable, Seurat, and Kandinsky, to name just a few, a highly developed, objective, structured approach to reality, an immense concern for order and relationship, and a continuous and disciplined ability to analyze and synthesize. There is then, in the light of such factors as reviewed above, a substantial and significant basis from which to challenge the cultural archetypes of Artist and Scientist. It suggests as well that the traditional polarization of Art and Science may be based on similar misconceived stereotypical assumptions and the remainder of this Chapter examines writers who explore relationships between the two fields themselves.

THE TRADITIONAL ART-SCIENCE DICHOTOMY:
THE LIMITATIONS OF EXCLUSIVE DEFINITION

Many writers have regarded the specialization and fragmentation of knowledge in the fairly recent past, as necessary but questionable progress. Certainly, there is a great deal written about the western tendency to "classify" knowledge, close it into disciplines and isolate it by initiation of its possessors into the socialized language and habits supposed to be peculiar to each field. (Bernstein, 1971) From this tradition of defining knowledge by boundaries, exclusive departments or disciplines have not only become the normative mode for ordering reality, but are usually defined by differentiation and often by dichotomy. Though not addressing himself to the Art-Science polarization specifically, Horton (1971) argues that the "well-worn" dichotomies of "Intellectual versus emotional; rational versus mystical; reality-oriented versus fantasy-oriented; ... empirical versus non-empirical, abstract versus concrete; ... " (Horton, 1971, in Young, pg. 228) act as inappropriate obstacles to understanding two fields. He is, of course, arguing for a less dichotomized view of scientific and traditional religious thought, but his arguments, and the polarized dichotomies he outlines, apply equally well to the archetypal view of science and art.

There is a substantial body of literature which purports to examine the relationships between Science and Art. An extensive bibliography on the subject of the pertinence of Art to Science, may be culled from literature on art criticism and aesthetics, yet, as Richardson (1971) points out, most works in these areas deal exclusively with art and touch on science as a "contingency." (Richardson, 1971) Much of the work in the literature outlined by Richardson relates the products of art to the applications of science, describes the historical influences of one field on the other, or relates some narrow aspect of one endeavour to an equally narrow aspect of the other.

Richardson himself however, deals with the history of ideas, and in the modern realm at least, exhibits strong parallels and similarities between the intellectual tendencies of modern painters and scientists. Although his critical views of other literature in the Art-Science area is fairly accurate in spite of its limited scope, he avoids works written outside the realm of art criticism, history and aesthetics. Thus, his suggestion that "all statements" concerned with relationships between Art and Science are "ceremonial" and "no longer tell us anything at all, " (Richardson, 1971, pg. xiii), lacks credence when other sources are examined. In fact, one finds, outside the exclusive areas using "Art" as their starting point, a substantial body of literature dealing with Art and Science, their relationships and similarities, which by no means would be considered "ceremonial."

Jacob Bronowski has provided powerful support for relationship and commonality between Art and Science and describes their traditional polarization in the following statement:

> It has been one of the most destructive modern prejudices that art and science are different and somehow incompatible interests. We have fallen into the habit of opposing the artistic to the scientific temper; we even identify them with a creative and critical approach.
> (Bronowski, 1960, pg. 5)

C.P. Snow (1964) has also drawn attention to the limitations of a view of Art and Science which fragments, polarizes and alienates them. It is perhaps unfortunate that Snow's Rede Lecture of 1959, "The Two Cultures," attracted the attention and support it did, though it served for many as a point from which to embark on further inquiry into Art-Science relationships. The unfortunate aspect of Snow's approach to the problem, is its weakness, generality and lack of deeper relevance beyond British intellectual literary and scientific circles. His thesis, though well-intentioned and perhaps implying more than was intended, has serious deficiencies and over-simplifications which tend to misrepresent and obscure deep relationships, by explicating superficial ones. This investigator would agree with Micheal Yudkin's (1962) criticism of the Snow "Cultures;" that the mere exposure of peripheral consequences of this major problem is an inadequate treatment of an important issue. Yudkin successfully points out that Snow avoids definition, stresses superficial remedies and lacks any deep insight into the importance of understanding the process and manner of scientific thinking. Even though Snow's relevance and insight are limited by nonsensical equations placing Shakespeare and the Second Law of Thermo-Dynamics in the same realm of experience, by simplistic suggestions of simply increasing factual literacy, and by superficial generalizations, he does, after all is said and done, express the problem. He did, as well, see commonality where many have seen only difference.

F.C.S. Northrop (1947) argues for identity and connection within Art and Science and points out that in certain stages or levels of inquiry, the logic of one is identical to the logic of the other. Through his definition of "logic," inclusive of broad and diverse means of knowing, he outlines the interdependency and epistemic correlation between the "theoretic" or scientific and "aesthetic" or artistic components of thought. His thesis is not easily defined in simplistic or general terms, but he points out clearly and irrevocably that the relationships between Art and Science are bound to modes of knowing reality which are complementary, and ultimately correlated. In addition, Northrop traces the dichotomous polarization of the two modes, aesthetic and theoretic, to cultural definitions of reality as typified by the West and East:

> The theoretic component of reality of the West, and the intuited or aesthetic component of the Orient are both ultimate and in part at least irreducible, the one being ... the epistemic correlate of the other.
>
> (Northrop, 1947, pg. 396)

He argues for a combined, comprehensive and integrative philosophy, which would include "in complementary harmony with balanced emphasis the most mature logical methods and attendantly profound insights of each." (Northrop, 1949, pg. 397)

Northrop's emphasis on combination, inherent relationship and integration of views of reality is echoed by Gyorgy Kepes, (1965, 1966), in almost all of his writings on Art and the Art-Science relationship. Kepes argues that scientific knowledge and artistic vision are not only highly interrelated, but that both exist "within a common structure of motivation, communication, and knowledge." (Kepes, 1965, pg. vii) He argues that Art and Science not only share the problem of vision, "in its deeper and creative aspects," but also that the most powerful imaginative vision, that which has created both art and science, is structure-oriented. That structure, says Kepes, is not only the connective foundation of both Art and Science, but is central to our ways of understanding the world as "an interconnected whole." Kepes stands as an example of those who not only challenge or reject the traditional Art-Science dichotomy, but who are working to replace it with a more holistic, inclusive, and synergetic pattern from which to view reality.

SUMMARY

This chapter has outlined literature which presents views of the relationships between Art and Science which challenge the currency of the traditional Art-Science dichotomy. The cultural stereotype of the Artist and Scientist was shown to be seriously in question, if not completely mythic, and alternative, integrative, non-polarized views of Art and Science were described. It is from the broad and inclusive theoretic framework outlined above, from the dissatisfaction with the traditional Art-Science dichotomy and its restrictive, stereotypical view of reality that this study draws its theoretical stance.

The next Chapter reviews literature specifically relevant to the methodology employed in the study and describes the organization and research design. It is there the reader will find mention of literature related specifically to the comparison of artists and scientists.

CHAPTER THREE

DESIGN OF THE STUDY

INTRODUCTION

In as much as this study is an attempt to describe and delineate commonalities shared by a sample of creative artists and a sample of scientists, it becomes, essentially, a study in human personality. Before any discussion, conjecture or analysis of common or different characteristics can be undertaken, either between individuals, or between groups, it is necessary to establish first an adequate descriptive measure for each individual. The manner in which one describes individuals and groups has, of course, been the primary concern, along with explanation, of psychologists in the field of personality. This is not to imply, however, that interest, commitment and research in the study of human nature, reside exclusively with the psychologists. Indeed, those working in the fields of anthropology, sociology, literature, and even metaphysics have long been concerned with personality, human nature, and the study of the individual in all his facets.

It is not difficult at all, in even a cursory glance at these various fields, to discover the existence of diverse theoretical and methodological approaches to human nature and personality. Although this study adopts the examination of personality only as a means for shedding light on the problem of Art-Science polarity, it should be clear that such means are necessarily of major importance if the end is to be accomplished. Thus, the explanation and rationale for the theoretical and methodological approach employed in this study provides the major content of this chapter.

In order to provide a clear view of the conduct of this study, this chapter outlines first, the actual design of the research, the samples, their selection, the gathering, analysis and approach to the data. The points for comparison between groups are also outlined and discussed.

In addition, the theoretical framework and phenomenological approach to personality are described and clarified. Finally, a brief review of relevant literature in the fields of personality and creativity, provides the background and context from which the methodology and approach to the individual were drawn.

THE DESIGN OF THE RESEARCH

The Samples: Selection of Individual Members

The samples consist of five artists and five scientists selected from history. These artists and scientists were selected from a larger list, and though they were not randomly selected, they were isolated as outstanding representatives of various branches of the Sciences and Visual Arts. The members of the original list, were isolated according to the following criteria:

a) Each individual was a recognized innovator who had made significant contributions to his/her field. (The "recognition," and "creative contribution" was defined by professional opinion and acceptability historically.)

b) Each individual must have had sufficient primary and secondary source data available in English or English translation, on his/her life and work, in order that sufficient description of their personality, habits and lifestyle could be obtained.

The original list of possible sample members, was then narrowed to ten, (five in the artist sub-group and five in the scientist sub-group), according to the amount of available data on each member. Thus, the final sample of ten represents those for whom the most complete description could be compiled, within limitations of time and resource.

Rationale for Sample Selection

Since any insight into the traditional Art-Science polarity with which this study is concerned rests squarely upon the results of examining the selected sample, it is essential at this point, that the rationale for their selection be stated. The most easily justified of the criteria for sample selection is, of course, the availability of data on each member. This criterion is a practical one, and responds to the limitations existing in dealing with an historical sample, and needs no further justification. Two other points, however, deserve further elucidation, the first being the emphasis on recognition and creative contribution, and the second being the decision to use an historical sample.

Restricting the sample membership to recognized artists and scientists who have been significantly innovative within their respective fields, avoids two distinct and troublesome problems. Such delimitation firstly is an attempt to address the problem of definition. The issue in this study is the search for commonality between artists and scientists rather than the definition of who is or is not an artist or scientist. Rather than engage in needless debate at the outset, over the qualifications of sample members to merit such labels, the investigator chose to restrict the sample to individuals who were clearly and acceptably defined not only by history, but by their peers, contemporaries and also by subsequent generations of professionals in the two fields. In other words, it is hoped, by this delimitation, to avoid the obvious objections that might be raised by a purely subjective definition of "artist" and "scientist."

The second problem avoided by the specification that sample members be recognized innovators, or highly creative individuals is also a definitional one. By such a specification the individual's creativity becomes a tacit assumption. T.S. Kuhn raises definitional differences between the "revolutionary" and the "normal" scientist, (Kuhn, 1970) which in some ways parallel art history discrepancies between the artist of genius, or "High" art and the artist of mundane or "Low" art. In that this study is an attempt, through the delineation of commonalities, to reflect on traditional assumptions about Art-Science polarity, it has turned to those members of each field which best represent the ideal or "stereotype" of the "Great" artist and scientist. In the final analysis, these "stereotypes" are a major contribution to the popular and traditional view of polarity between the fields. It is, then, with this issue in mind, that the sample was selected. It is also hoped, in this regard, that difficulties which might arise in comparing a brilliant physicist to a mediocre painter would be avoided. Finally, and perhaps as a concession to the personal interests of the investigator, highly creative individuals were selected in order that some insight into the creative process itself may be gained.

The final point of clarification concerning the sample selection and construction, is its historical nature. Why a study of historical figures? Why not living, breathing artists and scientists? Certainly the maxim that ninety percent of all the scientists in history are still living might cast some doubt on a sample of deceased individuals. This is certainly one of the major questions with which the investigator struggled, and for a number of reasons, arrived at the selection of an historical sample.

The first and ideologically most important reason lies in the traditional Art-Science paradigm and its popular acceptance. Such traditional polarization and stereotyping rests upon the popular understanding of the two fields. The vast majority of such popular understanding, and thus stereotyping derives from exposure to and comprehension of history and historical figures within both fields. To phrase it more succinctly, a sound case could be made indicating that the traditional Art-Science dichotomy rests squarely upon historical foundations. It can be assumed that the lack of genuine historical understanding of Art and Science has in many ways contributed to the prejudiced and biased view of polarity between the two. Both Kuhn (1970) and Jacob Bronowski (1960) make this point clearly and criticise the manner in which scientific history, at least, is transmitted and reinforces the popular stereotyping. The selection of an historical sample, then, is a conscious attempt to re-examine and re-illuminate the "stereotyped" artist and scientist, by a study of those who have provided the foundations for such stereotyping within these fields.

Another reason for utilizing an historical sample is to avoid the tendency for labelling newness in understanding, as change. In attempting to illuminate commonalities which have been ignored, neglected, or avoided, this study provides new insight into conditions which have existed, had they been viewed from a different angle, prior to as well as during the twentieth century. It is an attempt to view from an altered perspective a relationship which has always existed, rather than an attempt to create or invent a new relationship. If a contemporary, living sample were used, such relationships as might be found, could too easily be interpreted as changes, due to the twentieth century, where change has overtaken so many areas of life. Thus, one might be tempted to view such commonalities as are found as effects, or results of modern growth, and might remain with the impression that up until the nineteen hundreds, artists and scientists had nothing in common. Through an examination of a sample which represents various historical periods, it will be more difficult to dismiss commonalities as a mere function of historical or contemporary conditions.

The final reason for an historical viewpoint is practical, and again in some ways definitional. Few living artists and/or scientists are in the advantageous position of being viewed with hindsight. It is difficult to assess both the innovativeness and the recognized contributions of an individual who is still alive, perhaps not yet at the peak of their creativity, maturity or production.

The respect and acceptance which living artists and scientists, maintain within their fields is difficult to document and often subject to change. Finally, there is little data available on living individuals which might reveal aspects of personality, and even in cases where such data might exist, the capacity for growth and development in living members might render such data incomplete or invalid.

The Construction of the Sample as a Whole

Having established the preceeding criteria and rationale for the selection of individual sample members, there remain two factors which influence the structure and organization of the sample as a whole. Both of these factors may be viewed as efforts to minimize bias and subjectivity in sample construction. Historical bias or dependence is minimized through the distribution of the sample across historical periods. It would be well to note at this juncture that the historical periods to be surveyed or spanned by the sample begin with the Renaissance and end with the twentieth century (though excluding living members). The reasons for the exclusion of Pre-Renaissance sample members lie within the nature of that period. The Renaissance perhaps best marks the foundations on which modern definitions of Art, Science, the artist and the scientist are built. Bronowski points out that it is within the Renaissance which lie the origins of "the modern concept of man as an individual" (Bronowski, 1960). It might be imagined that the Renaissance concept of man the individual, the unique, secular being, was instrumental in leading to definitions based on difference which typify the Art-Science stereotypes which hold such currency in conventional wisdom today.

The Renaissance also provides a logical starting point in history, for it contributed greatly to the definition of "genius"or greatness in creative individuals. In addition, both Art and Science before this period were in most ways extensions of religion, or entirely influenced by it, and it is in the Renaissance where both fields begin to blossom independently. Finally, little documentation exists on individual artists and scientists of earlier historical periods, and that which does exist, tends to be unavailable in translation.

The second factor which influenced the construction of the sample as a whole, also concerns distribution. In addition to a representative historical distribution, the sample also exhibits representation of various specialist areas within the two fields. This factor is again an attempt to minimize bias and to avoid the limitations inherent in comparisons of narrow specialist groups (i.e. five painters as compared to five astronomers). The Arts, in this study deal exclusively with the Visual Arts, and representative sample members have been selected from painting, sculpture, architecture, and design. The Sciences, within this study, refer to astronomy, chemistry, physics, mathematics and biology. In the consideration of these final two limitations upon the construction of the sample, it was hoped to avoid for the most part, limitations which might arise exclusively from historical or specialist variables.

THE DATA

Sources

Data was gathered from both primary and secondary sources, including, letters, journals, diaries, personal documents, professional publications, and autobiographies of the sample members, as well as historical and biographical works written about them. Primary source data was given priority, and secondary source data was included only if it was authoritative or replicable.

Approach to the Data

Data on individual sample members was approached from the phenomenological viewpoint. This method was used to construct morphogenic descriptions for each individual sample member, and these descriptions were then used as the basis for the comparison and delineation of shared commonalities.

Before outlining the procedure for comparing or analyzing these morphogenic descriptions, it is perhaps necessary to outline and provide the rationale for the selection of the phenomenological method.

On the Phenomenological Method in Psychology

The term Phenomenology, or Phenomenological Method, as used within the parameters of this study, is less concerned with the philosophic movement or trend by that name and more concerned with the phenomenological method as applied at the psychological or personological level of inquiry. Although the philosophy, as articulated by Edmund Husserl, certainly is responsible for influencing psychology in many ways, approaches and methods in that field which might be described as phenomenological existed earlier than, and independently of, Husserl. (Misiak, 1970)

It is not, however, an easy task to untangle the "phenomenological method" from phenomenological philosophy, as Husserl articulated the method in his writings and saw himself it's implications and relevance for psychology. (Misiak, 1970) There were, and still are, though, many in psychology who employ the phenomenological method, or approach, but who would not term themselves phenomenologists in the philosophical sense. For these reasons, the phenomenological method in this study is described and employed only in its relation to personological inquiry. It is then, being employed herein as an heuristic tool and not as a philosophical stance.

The phenomenological method as applied to psychology, may be described as "a systemic observation and description of the experience of a conscious individual in a given situation." (Misiak, 1970,pg. 20) The exploration of an individual's consciousness includes both acts and experiences, phenomenal data consisting of anything which appears in consciousness, including memories, images, thoughts, perceptions and feelings. The method rests on the tacit assumption that it is only through the study of phenomena of consciousness that we may know reality, or the essence of reality. The experiencing of phenomena is the sole source of knowledge about phenomena. Thus, in relation to this study, the method of gaining knowledge of individuals is through examining those individuals phenomenologically, through their own conscious experiences, acts, feelings, perceptions and the meanings such experiences held for them.

The phenomenological method is essentially descriptive. Karl Jaspars describes it as "the completest more careful description possible of what is experienced by healthy or by sick people." (Misiak, 1970, pg. 34) Not only is the descriptive mode of primary importance in the phenomenological method, but also essential is its a-theoretical, unbiased approach to phenomenal data. Data is accepted and described without pre-suppositions, bias, or transformations of any sort. It is primarily concerned with describing the phenomena of conscious experience rather than explaining them according to pre-established frameworks or theoretical positions. Data is first described, then organized and analysed to arrive at essence or meaning.

The Phenomenological Method would seem especially suitable for application in this study for many reasons. Primarily, it focuses on all conscious experience and is thus holistic in its approach to the individual, rather than piecemeal or elemental. Also, it centres on specific descriptions of individual conscious experience and thus lends itself to morphogenic or ideographic description rather than nomothetic generalizations. It would seem, as well, that a sensible manner in which to gain knowledge of an individual is through a close examination of what he perceives, feels, thinks, and invests meaning in, as well as how he acts and consciously experiences his life.

Another equally important rationale behind the choice of the phenomenological method, is its disciplined attempt to retain openness, acceptance of data, and to reduce bias. Though it may be impossible to completely eliminate subjectivity or bias in the construction of phenomenological descriptions, a great deal of qualitative data will be included which might be omitted in a reductionist approach, and one hopes that the reader will have a greater amount of data on which to base his own conclusions. An approach which was pre-established or elemental in nature, without the a-theoretical and holistic aspects of the phenomenological method, might easily overlook data which did not fit into it's preconceived parameters. Thus, it's emphasis on the whole individual's conscious experience, at least renders the phenomenological approach a feasible and potentially productive one.

The final reason for the selection of the phenomenological method is a practical one, of perhaps the greatest significance. It was a response to the limitations of an historical sample, and the data sources being examined. It was obvious that a descriptive approach of some kind was necessary, and as the primary source data was certainly a record of the conscious experience of the individual, the phenomenological method seemed the most fruitful to employ. Though such data cannot be viewed as all the conscious experience of the individuals under study, it is certainly the only record and indication available, and as such cannot very well be viewed in any other manner.

To summarize to this point, the phenomenological method, of unbiased description of conscious experiences of the individual sample members was employed to construct morphogenic descriptions for each member. These descriptions will necessarily be limited to phenomena which seem relevant to the personality of the sample member.

Comparison and Analysis of the Data

Points of comparison and/or contrast between individuals and between groups, necessarily emerged throughout the research process, and the investigator was hesitant to delimit specific points of reference for comparison prior to research. However, even though some bias may occur, a general hypothesis and framework is impossible to avoid. Consequently, in an attempt to remain as emergent as possible, the points of reference at which to begin the search for common traits, remained general and open-ended.

Five broad aspects of personality were identified as starting points around which phenomenological data would be organized and compared. No committment to these specific five points was made, but rather a willingness to expand, change and/or delete them completely, accompanied their use.

Is was, however, in the best interests of time, data and a realistic approach to the problem, that the following five broad aspects of personality were isolated to serve as the preliminary framework within which to organize morphogenic descriptions. It should be noted here, that though these points do not stem from one particular theory or methodology in the personological tradition, they were selected to provide general yet varied guidelines for exploration. All of the selected points have appeared in research and literature on personality and would seem, individually, to be substantial and significant aspects of individual personality.

Broad Points of Reference in Personality

1) Modes of Thought -
   i.e. - thinking styles - problem solving approaches - mental capacities - intuition, etc.
2) World View -
   i.e. - level of consciousness - perceptions - mental sets - self-awareness - etc.
3) Creativity -
   i.e. - approach to creative process - role of rational, non-rational thought - motivation - play behaviour - traditional sets, etc.
4) Social Interaction (Behaviour) -
   i.e. - lifestyle - professional interactions - personal interactions, etc.

5) Social Consciousness -

i.e. - political - social awareness - relationship with authority - alienation - deviation from social norms - expressed value commitments, etc.

It should be noted once more that these aspects of personality are meant neither to be exclusive nor exhaustive. Factors which emerged throughout the gathering of data influenced the retention or rejection of these points and their use as a framework for comparison of commonality.

Analysis of Data: Delineation of Commonalities

The framework outlined above was employed as a starting point for comparative analysis within each sub-group. Thus each sample member was first compared with other members in his/her respective sub-group. From this analysis a list of commonalities for the scientist group was constructed, and one for the artist sub-group. Finally, a synthesis of shared commonalities was undertaken, and provided the delineation which was a major purpose of this study.

The delineation of commonalities provided the basis for the reexamination of the assumptions of the traditional Art-Science polarization which was the second major purpose of the study.

BACKGROUND ON METHODOLOGICAL FRAMEWORK AND APPROACH TO PERSONOLOGY

It would, perhaps, now be in order to provide the framework, background, and context within which the design and method of this study are situated. Any study which addresses itself, as does this one, to the careful, intentional study of human beings must inevitably confront the highly subjective issue of viewpoint, theoretical stance or philosophy. All methods of exploration in human personality rest squarely on the explorer's definition of man. Thus, the explorer who exclusively employs strict psychometric tests and quantification, inevitably must be committed to a theory which views human beings in measurable, quantifiable terms. Equally, the researcher engrossed in experimental studies of innate aggression and territorial instincts in humans, must inevitably find theoretical justification in Darwinism and evolutionary explanations of man.

Any theoretical framework or stance is to some degree subjective and speculative, especially those which concern human beings and their nature. To that degree, it will prove to be based on belief, faith, or personal philosophy, and thus will prove vulnerable to criticism and challenge. Certainly, a fanatic Christian, committed to the Biblical theory of the Creation, will differ radically from the Darwinian in belief, and thus may give little credence to research or its results based on a theoretical stance conflicting with his own.

In reviewing theoretical positions within the field of personality, this investigator found variance and disagreement as radical as one might find between the Christian and the Darwinian. Of additional importance, it became immediately clear that methods for describing and explaining human personality, and their corresponding theoretical frameworks were more closely and obviously related than research on innate aggression is to Darwinism. One is unlikely, for example, to employ Freudian psychoanalytic approaches to describing personality if one does not submit to the belief that man is controlled by unconscious, sexual drives.

It becomes obvious, then, that before decisions were made regarding the approach and method of describing personality, (i.e., the phenomenological method) consideration was given to the basic beliefs, assumptions and theories concerning man within which one might work. The methods selected are highly likely to determine the results of any research experience. "If the only tool you have is a hammer, it is tempting to regard everything as if it were a nail." (Maslow, 1969, pg. x). Thus, it is important for the reader to be informed of this investigator's view of the "nail" so that he may more clearly understand why a phenomenological "hammer" was selected.

As far as can be ascertained by this investigator, neither psychology nor philosophy has yet arrived at an "all-duty," "warrantied," or empirically verifiable definition for the phenomenon that is the individual. For this reason, more than any other, the theoretical framework within which this study operates, provides an open-ended, holistic and dynamic definition of the individual. The work of humanistic psychologists such as Abraham Maslow (1969) and Gordon Allport (1961), the growing emminence of phenomenological, existential and Gestalt theories of personality seem to point towards and support a view of man as an holistic, experiencing, conscious and growing individual. (Misiak, 1970)

Maslow, Allport and Carl Rogers, although differing in minor points, may be grouped together theoretically in their belief that man is a rational, pro-active, growth-motivated individual who can only be known if studied holistically as an integrated totality. (Hjelle and Zeigler, 1976) It is from this theoretical stance, and from these assumptions, that man is regarded within this study.

The search for a method which would adequately serve to examine the sample and at the same time remain consistent with this theoretical framework yeilded the phenomenological method. Theoretically, it seemed the most consistent through its emphasis on a holistic approach, in addition to its lack of bias. Though a great deal of research in personality within the past few decades has relied on experimental techniques, psychometrics and statistical analysis, much of it stems from opposing theoretical positions which regard man quantitatively. The qualitative nature of the phenomenological method, on the other hand, lends itself well to the holistic view. In addition, much of the modern research in personality stems from divisionist, or elementalist theoretical stances, exploring only selected aspects of personality rather than the whole individual. The tendency towards group rather than individual emphasis also predominates in psychometric and statistical approaches. For these reasons, as well as those mentioned in the previous section on the phenomenological method, it would seem the most consistent approach to employ within this theoretical framework.

REVIEW OF RELEVANT LITERATURE IN PERSONALITY AND CREATIVITY

In selecting creative artists and scientists to examine from a personological perspective, this study spans two broad areas of psychological literature; those of personality and creativity. Though a prodigious amount of research has accumulated in both areas, there is also a significant body of literature which focusses on the relationship between them. As with research in the broader field of personality, that focussing on personality and creativity, has for the most part, relied on experimental techniques such as those mentioned above. Numerous studies of creative personality have utilized such psychometric devides as Rorschach blots, (Roe, 1952), Thematic Apperception Tests (Roe, 1952-54), and a variety of personality scales, inventories and questionnaires. (M.M.P.I., 16PF, Eysynck scale, etc.). Very few studies have utilized biographical data, as does this one, and even fewer make use of an historical sample. However, P.E. Vernon (1970), in a comment on research in personality and creativity, states that "it would be foolish to neglect entirely the illuminating clues and suggestions provided by historical and biographical studies." (P.E. Vernon, 1970, pg. 312). He sites the biographical studies of personality by Galton, (1870), Cox (1926) and Havelock-Ellis (1946) as pioneering studies of this kind.

R.B. Cattell (1959) is one of the few modern personality researchers who has investigated outstanding creative individuals using biographical data. Though this research was un-used until a contemporary sample was explored for comparison (Cattel & Butcher, 1962), and though the historical sample was viewed in terms of a modern psychometric instrument (16PF Questionnaire), Cattell's results have relevance for this study. In the first place, he found significant similarities in personality between his historical and contemporary sample (comprised of scientists). This implies, at least, the feasibility of using biographical data. More importantly, in other studies, (Cattell-Drevdahl, 1958) using live samples, personality in scientists, creative writers and artists were found to be surprisingly similar. The studies of Roe (1952), Barron (1958), Mackinnon (1962), and others, using different methods and different sample groups varying from scientists to architects, suggest fairly similar results as those of Cattell. It is difficult to disagree, then, with P.E. Vernon when he states: "It would almost seem as if the differences between Science, Art and Literature are differences of particular skills and interests only, and that the fundamental characteristic of the creative, original person is a type of personality." (Vernon, 1970, pg. 323)

Further support for the biographical approach to personality can be found in the work of Maslow (1950), Allport (1965), and even Sigmund Freud (1916). It would seem then, that even in the face of modern psychometric and statistical techniques of personality assessment, that there is, indeed, a tradition of sorts, within which the biographical study of personality is acceptable and rewarding.

SUMMARY

In this Chapter the Design for the Research was outlined, providing a description of the Sample, the Data, and a Rationale for the approach to both. In addition, the Phenomenological Method was described and the justification for its choice was offered. The mode of analysis of the data was outlined and five points of reference for comparison were stated. Finally, this Chapter described the theoretical framework within which this study operates and briefly reviewed the literature relevant to a biographical study of creative personalities.

CHAPTER FOUR

THE SCIENTISTS

INTRODUCTION

Any process of inquiry or exploration which directs itself towards human personality must confront the difficult and frustrating task of maintaining a relatively strict focus on specific aspects of the individuals under study. In cases where the approach to personality is morphogenic rather than nomothetic, as is the case in this study, the task becomes more difficult. The researcher inevitably becomes entangled with ever more details and complexities which seem intrinsically woven into the fabric of each single individual. Personality becomes entangled with the individual's endeavour, and endeavour with history, history with the development of knowledge and so on, until the individual can rarely be perceived as separate from all which surrounds him.

This task of maintaining a single beam of focus on relevant aspects of the individual becomes more difficult still in biographical research, with its historical and anecdotal nature. The vast amount of varied data, viewed from the convenient and illuminating position of hindsight, constantly lures the researcher towards the fascinating though impractible road of dilletantism. In this study, where Science and Art both come under the beam of the investigator's focus, the historical development, the technical and theoretical issues, and the changing views of knowledge itself all provide additional and pertinent influences to tempt the explorer. And although exploration of these aspects throw light on the central issue of personality, it is necessary to avoid the hazards of becoming sidetracked. These hazards are unfortunately multiplied by the nature of biographical data, especially that which deals with "great men," for it more often focusses on the times in which individuals lived, and the work they did, than on the individual's personality. Finally, one cannot avoid the genuine curiosity and interest aroused by even a surface examination of such data, and thus, any investigator might find it impossible to avoid historical and theoretical aspects of both Art and Science. It will suffice to say that such a chain of inquiry, when started, can never be truly exhausted, finished or complete, and it is in this spirit that data presented herein should be viewed.

The parameters of this study make it neither feasible nor advisable to retrace the historical, theoretical or technical developments in Art or Science. It is the personality of an Einstein or a Picasso, rather than the development of relativity or cubism, which provides the focus in this work.

At the same time, without reference to such issues in theoretical physics and in painting, it is impossible to even catch a glimmer of the revolutionary natures of their creators, and in consequence to illuminate basic elements of their personality. It therefore, puts the researcher in the dichotomous position of needing to make references to issues outside of the boundaries of the study, in order to elucidate those within it. Such references can obviously be only of the briefest and most simplistic type, since any meaningful explication of such issues as quantum physics and Cubism should most certainly be left to the physicists, and the aestheticians.

Thus, in cases where further elucidation of such technical points is required, the reader has been provided with bibliographic sources where a fuller treatment may be found.

This Chapter deals specifically with the members of the scientific sample. It includes a single morphogenic description for each of the five scientists dealt with, as well as a concluding section synthesizing such common tendencies and similarities as are exhibited by them. In view of what has been said above concerning the difficulties in focussing on basic aspects, the descriptions are organized around the five broad points of reference outlined in Chapter Three. Briefly these are: (1) Modes of Thought (2) World View (3) Creativity (4) Social Interaction and (5) Social Consciousness. In employing such an organizational structure, the difficulties of comparing "apples and oranges" will be avoided. Thus, each individual will be described in accordance to the same points of reference and commonalities, if they exist, become obvious.

It should be noted at this point that the following descriptions cannot possibly provide more than an overview of the rich and diverse data which has been compiled on these individuals. The limitations of time, scope and location demanded that no complete or exhaustive biographical inquiry could be adequately undertaken in a study of this kind, and so, references to sources outside this study, are listed in the bibliography to provide direction to further and more detailed information. In addition, biographical data not specifically related to the five broad points of reference has been excluded (i.e. parentage, early schooling, etc.).

The intention of this Chapter is then, to present the basic descriptive data on the members of the scientific sample: Johannes Kepler, Charles Darwin, Herman Von Helmholtz, Neils Bohr and Albert Einstein.

Brief chronologies for each sample member may be found in Appendix A.

JOHANNES KEPLER: 1571-1630

Johannes Kepler is recognized by most authorities as the founder of modern astronomy, (Koestler, 1960), and certainly, even without that title, his experimental and theoretical work have left his place in scientific history without dispute. Kepler's Laws, though less popularized and less known than many scientific facts and theories, provided the basis for the discovery which was to mold the modern vision of the universe -- Newton's law of universal gravitation. Since the purpose here, is not to trace the development of such ideas, but rather to investigate the individual who held them, let it suffice to say that Kepler's Laws and their revolutionary impact on astronomy, create his place among the creative scientists in history, and thus his role in this study.

Kepler's world view, or definition of reality, not only provided the basis and beginnings for his subsequent work, but runs through his life and work with a force and consistency which make it a strong and meaningful aspect of his personality. It provides a starting point in his own work and in this way, an ideal point of departure for this investigation.

Kepler's view of the world and universe and thus, of reality, centred around harmony. He embraced the Copernican view of the sun-centred universe, a revolutionary concept accepted by few and dismissed by most acceptable astronomers of the late 16th century. His life was spent trying to identify and prove the laws of planetary motion which he felt must govern such a harmonious universe. He saw the universe as essentially unified by mathematical laws, proportions, and movement, and the entire body of his work speaks of his belief that such harmony is explicable by man and provides his attempts to explain it.

The "Mysterium Cosmographicum" -- published while he was twenty-five (1596) -- is perhaps a prime example of his world view, and his quest to clarify harmonious universal laws, even though the ideas propounded in it are entirely false. It's full title provides an indication of it's concern with the lofty ideal Kepler set himself in explaining a universe he believed was harmonious. It reads as follows: "A Forerunner (Prodromus) to Cosmographical Treatises containing the Cosmic Mysteries of the admirable proportions between the Heavenly Orbits and the true and proper reasons for their Numbers, Magnitudes and Periodic Motions." The "Mysterium" illustrates two points concerning Kepler's world view, and thus is worth examining briefly, as long as it is remembered that though the ideas in it led eventually to his Laws, and directed his work till his death, they were in themselves, essentially a false inspiration.

The first factor of importance in "Mysterium" is Kepler's wholehearted and zealous support of Copernicus. It was "the first unequivocal, public commitment by a professional astronomer, which appeared in print," (fifty years after Copernicus' death), (Koestler, 1960, pg. 50) and marks Kepler, even in his youth, as open to novel and even revolutionary ideas. It illustrates even more clearly, however, the obvious difference in world view between Kepler and his contemporaries.

His vision of the universe was neither the accepted nor the popular one.

The other, and more direct indication of Kepler's view of the world and universe is found in the body of "Mysterium" and reveals the major thesis of his thought at this time, and though his explanations would change, his belief in the harmony of the universe would remain throughout his life. The "principal proof" as he called it, argues that the spherical orbits of the planets are separated from each other by the geometrical forms of the five perfect solids. Setting aside the fact that such a notion is patently false, and perhaps even foolish, it must be noted that the whole of "Mysterium" is founded on the belief that "God could create only a perfect world, and since only five symmetrical solids exist, they are obviously meant to be placed between the six planetary orbits." (Koestler, 1960, pg. 51) In fact, Kepler's view of the harmonious and perfectly proportioned universe extended even to the positioning of his "perfect solids" between the imaginary spheres of planetary orbits.

Thus, for instance he (Kepler) writes,

> The regular solids of the first order [i.e. those which lie outside the earth's orbit] have it in their nature to stand upright, those of the second order to float. For, if the latter are made to stand on one of their sides, the former on one of their corners, then in both cases, the eye shies away from the ugliness of such a sight.
>
> (Koestler, 1960, pg. 51)

Thus, the "Mysterium" set the focus and direction of Kepler's work, which continues through "Astronomia Nova" (1609) where he elucidates his first two laws, and into "Harmonice Mundi" (1618) where he arrives at the Third Law. The over-riding world view set forth and used as a point of departure in all three works, is that of harmony and mathematical perfection throughout the universe. For Kepler, such harmony was irrevocably bound to God, and all his work is a curious blend of mysticism and empiricism. His religious beliefs provide then, another aspect which may illuminate the personality of the man.

Kepler was a tremendously religious man. His wholehearted adoption of the heliocentric Copernican view seems to have been for reasons which were equal in their religiosity to their logic. For him, the mystical and physical powers of the universe were centred in the sun:

> The sun in the middle of the moving stars, himself at rest and yet the source of motion, comes the image of God the Father and Creator .... He distributes his motive force through a medium which contains the moving bodies even as the Father creates through the Holy Ghost.
>
> (Koestler, 1960, pg. 60)

For Kepler, geometry provided the unifying truth between the mind of God and man, so even his use of strict mathematics was in his own eyes, a religious as well as empirical tool. His taste for the "beauty" of geometry was aesthetic as well as mathematical.

> Why waste words? Geometry existed before God, is coeternal with the mind of God, is God himself (what exists in God that is not God himself?); geometry provided God with a model for the Creation and was implanted into Man, together with God's own likeness -- and not merely conveyed to his mind through the eyes.
>
> (Koestler, 1960, pg. 60)

A final and most striking, example of Kepler's religious and scientific world view, both unified into his belief in harmony, is "Harmonice Mundi" (1618). It is as Koestler calls it, "a mathematician's Song of Songs 'to the chief harmonist of creation'." (Koestler, 1960, pg. 213) It is Kepler's attempt to synthesize geometry, music, astrology, astronomy, and epistemology in an all-embracing harmonious picture of the universe. It provides perhaps the best, and certainly the most fascinating picture of a man whose vision of the universe is at once harmonious, integrated and beautifully proportioned. It provides "archetypes of universal order" and harmonious ratios which Kepler sees echoed in all of creation.

Kepler's methods for arriving at his laws, theories and conclusion, combined hard, patient work, with an almost bizarre imagination as well as with an acute and uncanny ability as a "giant question-master." (Koestler, 1960, pg. 61) It seems that he singularly lacked a mind which was affected or overly influenced by the acceptable modes of thought, and he describes his own mind as "daring" (1601 - letter to Maestlin) and as having "ample imagination" (1619 - letter to Bianchi). His work, especially "Astronomia Nova" is an explicit indication of how he thought and dealt with problems, since he includes in it "the reasons, subterfuges and lucky hazards which led me to my discoveries." (Koestler, 1960, pg. 124) Koestler describes the style of this work as "unacademic, bubbly baroque ... personal, intimate and often exasperating." (1960, pg. 123) It is perhaps enough to say that the "Astronomia Nova" builds a picture of an adventurous mind struggling with the empirical facts and rejecting traditional approaches which would not fit them. He was forced, in order to discover the secrets of planetary motion, to make revolutionary innovations in traditional thought. These innovations and the subsequent arrival of the first two laws, were by no means a straight forward, cumulative linear process. Rather, he made ludicrous errors, struggled with mistaken ideas, back tracked, disproved his own arguments and finally emerged from the labyrinth having laid the cornerstone for a new astronomy, linked with physics as it has never been before. In "Astronomia Nova" Kepler wrote:

> Why should I mince my words? The truth of Nature, which I had rejected and chased away, returned by stealth through the back door, disguising itself to be accepted. That is to say, I laid [the original equation] aside, and fell back on ellipses, believing that this was quite a different hypothesis, whereas the two, as I shall prove in the next chapter, are one and the same -- I thought and searched, until I went nearly mad, for a reason why a planet preferred an elliptical orbit [to mine] -- ah, what a foolish bird I have been!
>
> (Koestler, 1960, pg. 147)

Aside from the enthusiasm and adaptability of his mind shown in "Astronomia Nova," his mind was extremely and continually rich in activity, yet focussed only on what interested him; he had a "peculiar kind of memory, which makes him promptly forget everything he is not interested in, but which is quite wonderful in relating one idea to another." (Koestler, 1960, pg. 37)

Reflecting on his work later, Kepler recalled "The roads by which men arrive at their insights into celestial matters seem to me almost as worthy of wonder as those matters in themselves." (Koestler, 1960, pg. 59) He had a remarkable ability to ask questions and to clear away the traditional or psychological roadblocks which obstruct the approach or interpretation of reality. He was able to recognize unexpected contexts, insights and to consider odd twists of thought which others might have dismissed as bizarre. It seems also, especially in "Astronomia Nova," that he had a deep intuitive "feel" for physical forces, an holistic impression of configurations involved, as well as deep mathematical intuition.

All of Kepler's work was motivated by his struggle to find truth, to discover the secrets of the harmonious universe. Such motivation and his passionate commitment to it, allowed him to turn the beam of his attention with intense focus on his work. In such a manner, he was able to cast off traditional ideas when he discovered they did not fit the facts of Nature. It was revolutionary in itself, that Kepler concerned himself so much with observational facts. Astronomy up to this point had been primarily metaphysical and Kepler stands out as a curious blend of the empirical and theoretical scientist. Had he given free reign to his imagination, without tempering it with his mathematical obsession for truth, he might have been lost to quackery. Two examples will suffice to indicate the sometimes bizarre imagination of the man, as well as his tendency to become obsessed with outlandish ideas. In between the publication of "Mysterium" and "Astronomia Nova," Kepler convinced Frederick, the Duke of Wurtemburg, to have a model of the universe, incorporating the five perfect solids, made in the shape of a drinking cup. This project, conceived in a grand style by Kepler, which served to waste his time for six months, and to frustrate him in later years, was never finished, since Kepler could find no silversmiths who could build it to his specifications. A brief description of Kepler's plans for this cup will suffice to indicate the direction of his imagination at this time. Various parts of the cup should be made by different silversmiths, and then fitted together, to make sure that the secret of this "true and perfect model of the world" would not leak out. Planets would be represented by precious stones, and the cup would serve seven kinds of beverages, conducted by concealed pipes from each planetary sphere to taps on its rim. Kepler went on to make a paper model of this oddity, but finally deserted the project in frustration.

If Kepler appears, out of this incident as a somewhat naive and comical figure, the father of modern astronomy spending months fiddling about with an unbuildable drinking cup, then one begins to intuit the essence of the man. His personality bears the stamp of youthful enthusiasm, imagination and innocence, as well as of dogged, committed determination and struggle. Later in his life, and still unfinished at his death, Kepler began work on "Somnium," perhaps the first work of science fiction in the modern sense. It illustrates not only his imaginative powers, but also, even late in his life, his love of new ideas, his sense of fantasy, play and humour and his lasting fascination with the Heavens. It is about a boy, who travels to the moon, and is in many ways cathartic in its autobiographical illusions; with fantastic flourish he creates a "cosmic scenery of scientific precision and rare, original beauty." (Koestler, 1960, pg. 251)

Kepler's relationship to people, both professionally and personally, presents a picture rich in strife and tragedy. He was capable of petty irritability when distracted, and he found even his marriages distracting, approaching them from a cool, rational stance. Yet, at the same time, we see him loyal to old teachers (especially Maestlin) to the point of hero-worship, devoid of jealousy or lasting resentment, and very much alone, with little congenial encouragement or support from colleagues or friends. He was not a social man, and his passions were directed towards work rather than family. He was happy to discard scientific ideas if they proved wrong, yet stubborn about his religious commitment even though he was heavily persecuted for it. He could not compromise scientific or religious truth, and thus was consistently at odds with authority in both domains, and was accused by most of "a passion for innovation." He refrained from active involvement in social and political affairs, yet in science, was an active advocator and defender of truth and change. In defending the Copernican concept he wrote in 1617,

> I take it as my duty and special task to defend it before the world ... with all the powers of my brain; for I have recognized it in my own mind as true and in contemplating it I am filled with unbelievable delight at it's beauty.
> (Bumgardt, 1951, pg. 120)

And though he made things difficult for himself, he refused to go along with all aspects of his Church, holding what may be termed, even by present standards, as a liberal, humanistic view. Kepler wrote to Maestlin in 1616,

> I will not take part in the fury of the theologians. I will not stand as a judge over my brethren; for whether they stand or fall, they are brethren of mine in the Lord. As I am not a teacher of the church, it will suit me better to pardon others and think well of them, rather than accuse and misinterpret them.
>
> (Bumgardt, 1951, pg. 120)

Thus, his fanatical passion for truth, his strong religiousity, his almost obsessive search for the harmony in God's Universe, did not contribute to any commitment to the conformity of the Church. He was deeply religious, but not passively conformist to Church doctrine, and was deeply disturbed when he was excommunicated, but stubbornly refused to re-cant.

Kepler's process of discovery combined an acute ability to synthesize and relate, hard and patient trial and error, intuitive leaps and openness and receptivity to new ideas and angles of approach. In most of his work his a priori proofs were arrived at a posteriori, and his mode of discovery or thought is perhaps best described by Koestler:

"We saw him (Kepler) plod, with infinite patience, along dreary stretches of trial and error procedure, then suddenly become airborne when a lucky guess or hazard presented him with an opportunity." He had the perception to see the opportunity and the ability to use it. "He was too sane to ignore reality, but too mad to value it." (Koestler, 1960, pg. 63)

CHARLES DARWIN: 1809-1882

Charles Darwin is best known for and usually associated with the concept of evolution; and though he is not responsible for discovering or inventing the idea, it is to Darwin that genetics and biology owe the modern theory and elucidation of evolution by natural selection. Far from inventing the notion, Darwin, rather, played the role of master synthesizer and provider of supporting observational data, and in so doing brought evolutionary theory its present acceptance and respectability in the modern scientific community.

Darwin's over-riding fascination with and belief in the laws of nature provide the central theme in his work and illuminate the core of his world view, or consciousness of reality. He believed there were consistent, harmonious laws governing all living things, and his life-long research and theoretical work on evolution may be seen as an attempt to uncover these laws. He approached Nature with an almost religious sense of awe, wonder and delight, combining with them, a determination and empiricism which appear consistently throughout his notebooks. He was at once worshipful and curious, struck by the beauty and analytical towards how it worked, an empiricist and a theorist.

In Darwin's view, God was replaced by the laws of Nature. He was, while younger, a skeptic and later became an atheist, but nevertheless, may be considered personally religious in his love and relationship to Nature. For him, it was Nature's laws which imbued the world with beauty and harmony and unity; and in such a view there is little need for a God.

Darwin's love of Nature, as well as a deep and profound appreciation of beauty, is reflected continuously in his descriptive writings and in the care and joy he took in collecting specimens. His approach to Nature was never cold, clinical or purely rational. One can sense the emotion and passion in all his investigations, from those of the minutest details of barnacles to those concerning the comprehensive theory of evolution. One excerpt from the "Beagle Journal" (1839) will illustrate his lack of pure clinical observation, as well as indicate the extent to which his senses were fully alive to the natural world.

> I have been wandering by myself in a Brazilian rain forest; amongst the multitude it is hard to say what set of objects is the most striking; the general luxuriance of the vegetation bears the victory, the elegance of the grasses, the novelty of parasitical plants, the beauty of the flowers, the glossy sheen of the foliage. All tends to this end. A most paradoxical mixture of sound and silence pervades the shady parts of the wood; the noise from insects is so loud that in the evening it can be heard even in a vessel anchored several hundred yards from the shore; yet within the recesses of the forest, a universal stillness seems to reign.
> (Darwin, 1839, pg. 11)

The "Journal of Researches" from the Beagle, is full of passages which relate the youthful wonder, enthusiasm and sensual pleasure in Nature which Darwin maintained throughout his life. No aspect of living things was too small or too complex to stimulate his interest and demand his full attention. Aside from "Origin of Species", his major work on evolution, he did research and published on coral reefs, geology, barnacles, and numerous varieties of plants and their breeding habits. Eight years were spent on barnacles alone, and indicate the patience and single-minded focus on detail which he integrated with his ability to maintain diverse interests and examine a broad variety of problems.

Exploring Darwin's Journals and Notebooks, one sees him emerge as a man with a holistic approach to reality, believing in a stable harmonious natural order, in which there are no limits on the intelligence or complexity of natural organisms, where the interaction of all living forces maintain evolution as eternally emergent. His 'Weltanschaung' becomes increasingly apparent when his reverent, playful, almost poetical approach to Nature is considered, beside his painstaking documentation of observational data. In Darwin, there was an interplay between abstract thought and practical activity, between theory and detailed observation. The Theory of Evolution was essentially a master synthesis, which could have been achieved only by some one with Darwin's ability to alternate between these two modes of thought.

> To see more deeply into nature he needed the perceptual, intuitive, direct contact with the material. To understand what he had seen and to construct a theory that would do it justice he had to re-examine everything incessantly from the varied perspectives of his diverse enterprises.
>
> (Gruber, 1974, pg. 113)

Darwin had the ability to perceive anomolies, to ask questions, and in confronting conflicting conceptual points, to synthesize them into a stable, coherent, integrated structure. He did not hesitate to take the evolutionary ideas of Erasmus Darwin, Larmarck and Diderot, the concept of natural selection from Lyell and Blythe, examples of adaptation to environment provided by his own and Paley's observations, and mold them together into the theory of evolution by natural selection.

His modes of thinking and methods of discovery were contrary to the legitimate and accepted methods of the empirical scientists of the nineteenth century. Not only his results but his mode of arriving at them, was revolutionary for his time. Gruber states in "Darwin on Man," that Darwin's method of working "would never have passed muster in a methodological court of inquiry among (Darwin's) scientific contemporaries." (Gruber, 1974, pg. 122) Rather than working from facts to simple and then more general laws, or along the same route but in the opposite direction, Darwin's notebooks indicate an untidy sequence of often unrelated topics and methods, tumbling over each other at different rates and with varying degrees of importance. He was, at almost all times, and at the same time, theorizing, observing casually as well as in a structural manner, experimenting, reading, questioning, and revising ideas in many fields at once; botany, geology, entymology, evolution, etc.

He focussed vast amounts of energy and time on his work, and even though such a variety of ideas led to confusion, he was consistently sorting it out, finding order within a framework which gave meaning to facts which appeared to most, unrelated. In referring to his own thought processes, Darwin describes connective thinking, involving complex and parallel streams of thought as exhausting, hard work, but notes how easily he is able to lose himself in flights of imagery, disconnected thoughts, music and daydreams. (Darwin, 1958) His notebooks are spontaneous, often slap-dash, filled with odd juxtapositions of ideas or observations, and indicate an ability and delight in intellectual work and play. His mind was constantly at work, and thus saturated and fertile so that sudden insights could be linked and given context. His mind was welcoming and inquiring, his intuitive feel for natural forces and details put him in the position of being able to grasp the significance of ideas, memories and new observations. Thus, while struggling to find the final link in the Evolutionary Theory -- his mind was ready to grasp at the significance of Malthus' "Essay on the Population," and to assimilate its relevance for natural selection. He was, then, both highly motivated and saturated and therefore able to see the link, and put it into place. It was an act of insight to see it and synthesis to use it.

In addition to the thinking methods, observational skills and obvious love of Nature Darwin exhibited, he also maintained throughout his life a youthful innocence and playful sense of humour. In some ways it seems odd to observe a revolutionary scientist who's theoretical writings are clear, concise and supported by observed fact, respond to Nature as follows -- "It is nearly impossible to give an adequate idea of the higher feelings which are excited; wonder, astonishment and sublime devotion fill and elevate the mind." (de Beer, 1963, pg. 40)

The passion was not transferred into Darwin's relationships with people, though the child-like innocence was, and with some, the playfulness. Though his wife was deeply loved, his family was important and his friends were respected and affectionately admired, there is little evidence to suggest that he was anything but cool and fairly unemotional in his dealings with people. Before he married he spent considerable time computing the positive and negative advantages of such a decision. It is a rational and yet humourous document, in which he draws out the argument from both points of view, finally deciding that marriage was the better of the choices. He lived a quiet life, and remarked once that his illness was an advantage as it kept him from social distractions. He was hesitant about publishing, disliked controversy, and avoided argument as much as he could. He was well aware of the revolutionary nature of his ideas on evolution and though he disliked public debate, when he finally chose to publish, and the understandable controversies arose, he was stubborn and determined to hold his ground.

> ... they may attack me to their heart's content. I am got case-hardened. As for the old fogies at Cambridge, it really signifies nothing. I look on their attacks as proof that my work is worth the doing. It makes me resolve to buckle on my armour.
>
> (de Beer, 1963, pg. 153)

And in "Origin," he had attacked the traditional and accepted views, fully aware of the consequent uproar which he knew must (and did) follow.

> Do they really believe that at innumerable periods in the earth's history, certain elemental atoms have been commanded suddenly to flash into living tissues? Do they believe that at each supposed act of creation one individual or many were produced? Were all the infinitely numerous kinds of animals and plants created as eggs or seeds or as full grown? ... and in the case of mammals were they created bearing the false marks of nourishment from the mother's womb? Although naturalists very properly demand a full explanation of every difficulty from those who believe in the mutability of species, on their own side they ignore the whole subject of the first appearance of species in what they consider reverent silence.
>
> (Darwin, 1884, pg. 423)

Such hard-headedness and skepticism in his position on traditional religious views of Creation, were typical of Darwin. At the same time, he was a gentle and "transparent" man on a personal level and had a dry and whimsical humour which found its way into his notebooks and letters to friends. He drew those around him into his work, used his own children to observe adaptations, personified his specimens, and was occasionally mischievous. He playfully hid in one of Huxley's classes one day to listen to him teach Darwinian theory.

He was liberal and humanistic in his social and political views, was anti-slavery, a pacifist and violently opposed to cruelty of any kind. He was non-active however, uninvolved and not terribly aware of political or social problems, and so can not be considered in any way to have been committed enough to any stated values to take action for them. As a young man, Darwin was easily bored by authority and though not overly rebellious, neither was he overly acquiescent.

It is obvious however, from the nature of his work, and its attack on the traditional views held by authority at the time, that he had little interest in conforming and even less respect for the established order of things. He had interest and respect only for the laws of Nature.

He said of himself, in explanation for any success he had as a scientist ...

> I think that I have become a little more skillful in guessing right explanations and in devising experimental tests; ... I have no great quickness of apprehension or wit which is so remarkable in some clever men, for example Huxley. I am therefore a poor critic; a paper or book therefore excites my admiration, and it is only after considerable reflection that I perceive the weak points.
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> My memory is extensive, yet hazy; it suffices to make me cautious by vaguely telling me that I have observed or read something opposed to the conclusion which I am drawing, or on the other hand, in favour of it ... I think that I am superior to the common run of man in noticing things which easily escape attention, and in observing them carefully. My industry has been nearly as great as it could have been in the observation and collection of facts. With the exception of the Coral Reefs, I cannot remember a single first formed hypothesis which had not after a time to be given up or greatly modified. My habits are methodical, and this has been of not a little use for my particular line of work. Lastly, I have had ample leisure from not having to earn my bread. Even ill-health, though it has annihilated several years of my life, has saved me from the distractions of society and amusement. Therefore, my success as a man of science, whatever they may have amounted to has been determined, as far as I can judge by complex and diversified mental qualities and conditions.

> Of these, the most important have been, the love of Science, unbounded patience in long reflecting over any subject, industry in observing and collecting facts, and a fair share of invention as well as common sense.
>
> (Darwin, 1958, pg. 140-142)

HERMANN VON HELMHOLTZ: 1821-1894

Hermann von Helmholtz has been described as one of the most "versatile" men in history of modern science. Though he is not well-known for one particular discovery or invention, he made first rate contributions to diverse fields such as biology, mathematics, optics and perception, medicine, electrodynamics and acoustics. He was a prolific experimenter, theorist and writer, and was equally fluent in his endeavours in theoretical physics as he was in physiology. He involved himself in so much, in fact, that it is difficult to pin-point exactly what contribution most signifies his standing in the history of science. It is perhaps simpler then, to turn to the testimony of Lord Kelvin, to find Helmholtz's position within the broad realm of scientific endeavour. He writes, "In the historical record of science, the name Helmholtz stands unique in grandeur, as a master and leader in mathematics, and in biology and in physics." (Koenigsberger, 1960, pg. ii)

An overview of Helmholtz's vast and diverse body of work quickly illuminates the dominant core of his world view -- the interconnectedness of natural phenomena and the laws under which they functioned. In addition to this integrated view, he was strongly empirical and believed metaphysical speculation had no place in the sciences. Thus, Helmholtz carried out countless experiments, and wrote prolifically in areas which inter-related physiology and physics, mathematical optics and anatomy, physiological acoustics and aesthetics, as well as thermodynamics and electricity. He thus emerges as a scientist and a man with a broad and integrated concept of the world, searching continually for an empirical basis for the general laws of Nature.

His love of science and of Nature was deep and profound, and not limited to a merely cold, analytical view of phenomena. Rather, he was highly sensitive to beauty and aesthetics and felt that Art and Science maintained "profound internal relations." (Koenigsberger, 1906, pg. 172) His interest in such seemingly diverse endeavours was not superficial, but deeply emotional, highly enthusiastic and almost youthful in the immense delight he took in exploring and discovering the natural world. His letters to friends and family are filled with enthusiastic and sensitive descriptions of his travels, nature, art, people, and observations concerning science.

Even though he maintained such intense and varied enthusiasms, Hemlholtz was a diligent and disciplined worker. He would direct his total energies into every endeavour, and often worked himself to the point of physical and mental exhaustion, so that one finds him taking summer journeys, mountaineering and walking to recoup his energies and rest his mind. In fact, he regarded such excursions to the mountains as a kind of cure from his long, intense periods of exhausting work.

Helmholtz's methods of problem-solving and modes of thought are perhaps best described by himself, in the following passages:

> I have been able to solve a few problems in mathematics and physics, including some which the great mathematicians had puzzled over in vain from Euler onwards ... But any pride I might have in my conclusions was perceptibly lessened by the fact that I knew that the solution to these problems had almost always come to me as the gradual generalization of favourable examples, by a series of fortunate conjectures, after many errors. I am fair to compare myself with a wanderer on the mountains, who, not knowing the path, climbs slowly and painfully upwards, and often has to retrace his steps because he can go no further -- then, whether by taking thought or from lack, discovers a new path that leads him on a little, till at length when he reaches the summit, he finds to his shame that there is a royal way, by which he might have ascended, had he only had the wits to find the right approach to it.
>
> (Koenigsberger, 1906, pg. 180)

> A pioneer in science, or an artist, who has a repeated run of happy accidents, is indubitably a priviledged character, and is recognized as a benefactor of mankind. But who can count or weigh such lightning flashes of the mind? Who can trace out the secret threads by which our conceptions are untied? ... I must confess, that the departments in which one had not had to trust to lucky accidents and inspirations have always had the greatest attraction for me. Yet, as I have often been in the predicament of having to wait on inspiration, I have had some few experiences as to when or how it came to me, which may perhaps be of use to others. Often enough it steals quietly into one's thoughts and at first one does not appreciate its significance; it is only sometimes that another fortuitous circumstance helps one to recognize when, and under what conditions it occurred to one; otherwise it is there, one knows not whence. In other cases it comes quite suddenly, without effort, like a flash of thought. So far as my experience goes, it never comes to a wearied brain, or at the writing table. I must first have turned my problem over and over in all directions, till I can see its twists and windings in my minds eye and run through it freely, without writing it down; and it is never possible to get to this point

> without a long period of preliminary work. And then, when the consequent fatigue has been recovered from, there must be an hour of perfect bodily recuperation and physical comfort, before kindly inspiration rewards one. It often comes in the morning upon waking up ... It came most readily ... when I went out to climb the wooded hills in sunny weather. The least trace of alcohol, however, is sufficient to banish it. Such moments of fertile thought were truly gratifying, but the obverse was less pleasant when the inspiration would not come. Then I might worry at my problem for weeks and months till I felt like a creature on the barren heath...
>
> (Koenigsberger, 1906, pg. 209)

Helmholtz had highly developed observation skills and a genuine sense of play and experiment. Noting something accidently often led to further exploration as his observation of a cloud storm forming led him into his meteorological investigations. He was constantly constructing models and contraptions with simple and primitive materials, playfully using everything from his wife's serving spoons to kitchen utensils. He enjoyed play-acting and often read plays aloud with friends and family. He was deeply fond of music, played the piano extremely well and even painted in watercolors. He delighted in sharing his enthusiasm for Nature with his family, and he was continually showing his children mathematical experiments, natural phenomena and wrote with the intensity of his enjoyment in art, music and Nature, to his wife.

He seems to have been a generally cheerful and sympathetic man, though strongly in need of the emotional harmony, support and companionship of a healthy marriage. The death of his first wife, completely incapacitated him for work, and he felt strong needs for personal security. His strong love for art and science, his interests in aesthetics, had never been eclipsed by even his profoundest affections, but in the absence of a stable harmonious relationship, he felt the "danger of atrophy." He re-established his positive outlook by remarrying, and threw himself with renewed vigour back into his work.

His relationships with others are marked with a generosity of spirit and a calm equanimity that few, if any, ever saw disturbed. His home was the scene of stimulating social interaction, but he rarely left it for sociality, being too involved in his work. He was continuously open to new ideas, lacked any kind of professional jealousy, and was generous in his praise and encouragement of others. He was not, however, unaware of the early critics of his work, or the early opposition to his stress on the empirical method, (which was at that time not as established as it was later in his life). His first treatise on the Law of Conservation of Energy was met with much opposition because he had been "the first to set down a universal law of experimental science, and to purify it and free it from vague philosophical and speculative reflections." (Koenigsberger, 1906, pg. 43)

He was aware of the novelty of his views and wrote,

> In the early years, nature philosophy was still rampant among the students and the scientific circles of the city (Konigsberg) often took cudgels against my attitude. I never set myselt aggressively ... but left the weight of the facts to speak for itself ...
>
> (Koenigsberger, 1906, pg. 138)

He did not hesitate to question previously established and well accepted views, and felt that science should rid itself of all but empirically based hypothesis. He felt that,

> it is unworthy of a would-be scientific thinker to forget the hypothetical origin of his propositions. The arrogance and vehemence with which such masked hypothesis are defended are, as a rule, the consequence of dissatisfaction which their champion feels in the depths of his consciousness about the validity of his contention.
>
> (Koenigsberger, 1906, pg. 284)

Most likely related to this contempt for metaphysics and non-empirical speculation, Helmholtz avoided extremes in both religious and political matters, and seems to have avoided active participation in either domain. Though his view of research and scientific endeavour might be viewed as religious in some senses. He describes the world of the researcher in the following terms:

> The entire conceptual world of civilized humanity comes before them as a living growing whole, which in comparison to the brief life of the individual appears to be eternal. Such a one regards himself, in his own small efforts towards the building up of science, as a minister in an eternally righteous cause, with which he is linked by the closest bands of love ... Thus, even to himself, his work is consecrated.
>
> (Koenigsberger, 1906, pg. 309)

An overview of Helmholtz's creative and intellectual grasp on science is provided by his friend and biographer, Koenigsberger. Helmholtz displayed, he wrote,

> an illumination in his view of scientific problems, and elevation of philosophical conception, ... a purposeful attitude in regard to the riddles and mysteries of nature, a grasp of all the resources of thought and feeling available for the investigation of the whole field of human knowledge, such as are seldom met in the history of the sciences ...
>
> (Koenigsberger, 1906, pg. 208)

NIELS BOHR: 1885-1962

Niels Bohr was a theoretical physicist. Though perhaps lesser known than Einstein, he was in many ways a greater revolutionary. Bohr was an integrative theorist, continually molding together different points of view to create theory more closely linked to experience, and his greatest contribution was the application of the quantum postulate to atomic theory. His work in this area was a strong break from classical physics, and most of our present concepts of atomic theory and nuclear physics may be traced back to the work of Neils Bohr.

Perhaps the most over-riding element in Bohr's view of the world, or of reality, was that of unity. He was deeply holistic, believing that there can be no distinction between the detail and the whole. "You cannot treat the large scale and the details separately -- both are equally important to the whole." (Rozental, 1968, pg. 175) His friend and colleague, Kalckar, described Bohr's world view -- or consciousness of reality as follows -- "

> ... it was a way of viewing, or of approaching phenomena. Bohr possessed the eye of the initiated for the inward connections of nature. He saw unity where others saw merely a chaos of facts ... He conceived the Universe as unambiguous in the sense that no detail could be changed without spoiling the whole balance of logical coherence.
>
> (1968,pg. 233)

Bohr viewed human knowledge as unified, and viewed the sciences themselves as connected opportunities for examining the harmonies in

Nature and of tracing the unity of knowledge. His view of science as a heuristic tool, integrated and un-isolated from the rest of human endeavour is summed up by his feelings towards mathematics.

> Mathematics is therefore, not to be regarded as a special branch of knowledge based on the accumulation of experience, but rather as a refinement of general language, supplementing it with appropriate tools to represent relations for which ordinary verbal expression is imprecise or too cumbersome.
> (Bohr, 1963, pg. 9)

He maintained a single, unifying, basic view, which, rather than leading him to barren schematizing, supplied him with a framework within which to learn. "Indeed, just the possibility of finding room for the most varied human experiences with the framework of the complementary description showed him the way to attain balance and harmony in existence." (Kalckar, 1968, pg. 235)

His revolutionary advances towards quantum physics were in part due to his broad view of logical unity and his belief in the necessity of harmonious Nature. He was free of the mental restrictions of classical physics because he saw that they did not account unambiguously for experience.

> Bohr was completely unaffected by the current philosophical systems, because he saw clearly that the fundamental issue was the unambiguous communication of experience -- a problem which there is as little hope to solve by forcing such an account of experience, irrespectively of the conditions under which it is obtained, into the straight jacket of some preconceived logical frame, as by appealing to some form of mysticism, of irrational perception whose subjective character would make it unfit for communication.
> (Rosenfeld, 1968, pg. 116)

Bohr had the vision to perceive anomalies and inadequacies in the structure of classical mechanics, and because he faced the problem with "a mind so singularly free of prejudice," he succeeded in solving it with his principle of complementarity.

Bohr's unified world view provided the basis for his interest and fascination for all aspects of life, and he had an ardent curiosity, a deep love of Nature, and a boyish, often innocent ability to become intensely involved in everything he saw as important. He was highly enthusiastic, vigorously involved in everything he did, and displayed a remarkable ability to relate and integrate the smallest everyday things to broader theoretical conjectures of "finding problems in everyday things ... observations would start off trains of thought regarding causes ..." (Rosental, 1968, pg. 22) His mode of thought, and approach to problem-solving seems to have hinged on his holistic sense. His work in theoretical physics is a masterful integration of Rutherford's atomic model, Planck's quantum and Balmer's mathematical formulas, a conceptual synthesis which seems to rest at the core of his thinking processes. It is seen later in his theory of complementarity, and in his life-long tendency to seek harmony and unity in Nature and life. There was "... the desire for harmony without sacrificing either the claims of logic or those of experience. While most people tend to notice the differences between similar things, it was natural for him to see what was common to apparently different ones." (Klein, 1968,pg. 74-75)

Bohr worked largely by combining his critical and logical faculties, "his sense for seizing on the fundamental features or consequences of a theory, and comparing them with assumptions or experiences upon which the theory is based," (Rozental, 1968, pg. 35), with a deep intuitive grasp of phenomena. Werner Heisenberg describes this intuition;

> Bohr's insight into the structure of his theory was not the result of mathematical analysis of the basic assumptions, but rather of an intense occupation with the actual phenomenon, such that it was possible for him to sense the relationships intuitively rather than derive them formally.
>
> (1968, pg. 96)

His intuition and analogous methods were sharply honed and always active, and he was able to achieve qualitative and semi-quantitative results without detailed calculations.

He worked through discussion and argument, using conversation as a dialectical tool for developing his ideas, revising, clarifying and resolving contradictions. He constantly sought deeper meanings and implications and was rarely satisfied with the products of his labours, always desiring to go further, deeper into the issue, to uncover purer unity.

> It was this urge of Bohr's to look for the deeper logical aspects of the problems presented by the analysis of physical phenomena, as much as his uncanny intuition for their essential features and his supreme ability to trace at one glance their wider implications, that gave him a unique position among physicists.
>
> (Rosenfeld, 1968, pg. 118)

Bohr was totally caught up in his thirst for knowledge, he constantly revised his work, and was always delighted and anxious to hear the ideas of others. He was unafraid of error, and maintained throughout his life an open-mind. He once related to one of his students that he had to approach every new question from a starting point of total ignorance. He appraised contributions to physical research from the stance of "What have we learned," and even in his own domain of physics, "the vital point for him was not, after all, the concrete problems and their solution;" (Kalckar, 1968, pg. 223) but rather the process of continually achieving a greater understanding of Nature itself.

Kalckar, a young student and colleague of Bohr's describes his curiosity,

> Bohr's desire to learn was not, however, restricted to the field of natural sciences but embraced human development in all domains of knowledge. His curiosity could be aroused by a technical invention as well as by a new hypothesis as to the authorship of Shakespeare's plays.
>
> (1968, pg. 232)

Indeed, he was challenged equally by theorizing on the phenomenon of gunmen and gunfights in movies, as on physics. He was often distracted, his imagination being swiftly caught by new challenges, and the enthusiasm and the intense single-mindedness with which he attacked problems often led to divergence from a main goal, only to return to it later.

Bohr was not only highly curious, but highly playful as well. He delighted in working with his hands, building small models for experiments, and constructions to illustrate some idea or another to his children or colleagues. He loved Nature and spent a great deal of time outdoors, walking, hiking and sailing, and seems to have invested as much energy and focus into such activity as he did in physics. He enjoyed youthful pastimes, and often threw stones at objects to test his aim and distance. Heisenberg (1968) describes such times with Bohr spent walking, and engaging in stone throwing contests. "Bohr told me," he said, "that he and Kramers' had once found a mine left over from the war, and they tried to see which one of them could hit the detonator. After several vain attempts, they realized that they would never be able to enjoy the victory if they had hit it, for the explosion of the mind would have killed them both." (Pg. 96) Many such instances of Bohr's boyish delight in throwing stones are told, and his gunman theory developed after seeing western films, and practiced with his students using toy guns, also testifies to his enthusiasm for games and play, and his ability to integrate them into his broad interests.

He loved conversation and needed verbal expression badly to work out his thoughts. In fact, his favorite method of working was thinking aloud --

> To have some one with whom he could feel free to think aloud, on whom he could literally try out the formulation of his ideas, test its adequacy to fulfill the all important function of communication. From time to time, he would dictate, a few sentences embodying the progress of the argument; these were rather meant to help the partner, for his own remarkable memory made such records superfluous to him. In fact, he would hardly ever look

> at these notes, but would rather redraft the sentences afresh, again and again with inexhaustiable patience, slowly approaching the carefully balanced form he would at long last deem fit for publication.
>
> (Rosenfeld, 1968, pg. 119)

In such discussions, he was direct, vigorous, and expressed himself with "drastic imagery and strong expressions," while his writings and even his public lectures, he was often difficult to follow, involved and indirect. He was essentially a verbal person, writing very little work with his own hand, usually dictating for some one else to write. Apart from a few letters and short notes, there are no manuscripts extant in his own writing. He did however, as much as he disliked writing, need to visualize and make concrete ideas in discussion, and one would never find Bohr too far from a blackboard.

In addition to his verbal expressive needs, and those demanding the sounding board of others in discussion, Bohr needed to share his enthusiasm, joy and intense involvement in his subject with others. He needed complete harmony in order to work, and used argument, rather than authority or power, to elicit support and enthusiasm for his ideas in those around him. He emerges as deeply emotionally involved in his work, and as a man who wished everyone around him to share his enthusiasm.

His friend and colleague, Leon Rosenfeld (1968) writes,

> ... thus Bohr's creative work imposed on him not only the utmost concentration, but a peculiar emotional strain; for him the exploration of nature was never dissociated from it's human implications, insight into it's laws was not complete without an

> adequate formulation and communication, and the adventure of discovery was a communion of the human mind with Nature which he experienced with dramatic intensity.
>
> ... So intensely did he feel the excitement of the quest and the joy of the achievement that he wanted everyone around him to share it with him. Even after many years he would remember every detail of the argument's progress and he would repeatedly tell the story with the same freshness and animation.
>
> (pg. 117)

Bohr's excitement and natural tendency to share it, finds its way into most of his human relationships, personal and professional. His students recall him as an excellent and dynamic teacher, kind, concerned, intensely involved, but always ready to learn and to be encouraging. Frisch recalls a first impression of the relaxed, jovial and somewhat unconventional atmosphere at Bohr's Institute in Copenhagen;

> From one of the early colloguia the scene of a discussion between Bohr and Landau is imprinted on my mind ... Bohr bending over Landau in earnest argument while Landau gesticulated at him, lying flat on his back on the lecture bench, (neither seemed aware of the unconventional procedure).
>
> (Frisch, 1968, pg. 138)

The atmosphere at his home and summer house is remembered by almost all who went there as relaxed, comfortable and always stimulating, where one might find Bohr playing games, telling jokes, expanding his theories on modern painting, discussing physics, or out in the yard pulling up weeds with the focussed energy he applied to everything.

Bohr had a great ability to question and doubt which aside from its obvious contributions to his work in theoretical physics, influenced as well his attitude towards authority, in general. He remained "aloof from any manifestation of religion, orthodoxy or mysticism," though he was not uninterested in them as phenomena to investigate for their social and psychological roots. He was, in fact, quite fond of telling stories about Eastern teachers (especially Lao-tse and Buddha) and used to relate how they understood the futility of asking for an answer to the question of the meaning of existence. "They understood," he said, "that any use of the word 'meaning' implies a comparison, and with what can we compare the whole of existence?" (Rozental, 1968, pg. 238)

He did not, however, remain aloof from social issues, though he did not involve himself in a highly active way. He was deeply concerned, and continually interested in furthering understanding in humanistic matters, as well as in those of science. During the Second World War, he argued for openness concerning nuclear weapons, hoping to convince both Roosevelt and Churchill of the incredible dangers involved in continued secrecy. He was also highly optimistic and hopeful about the beneficial potentials which nuclear power offered mankind, yet in his open letter to the United Nations, (June 9th, 1950), he does not appear naively optimistic, but well aware of the problems facing man in meeting the challenge of such power as science had given the world.

He was highly humanistic, sensitive, and socially conscious, striving for greater understanding and co-operation between scientists and their nations. The Institute at Copenhagen, not only was the meeting and working place for international groups of scientists, but Bohr himself, during the Second World War, helped many to escape Nazi Germany and re-locate elsewhere.

Bohr's versatility, and the diversity of his interest ranged not only from physics to world politics, but also embraced literature, art, history and sailing. He had a special love for old Icelandic sagas and Scandanavian tales, and read them aloud with a lyrical and poetical sensitivity which is also expressed in his love and enthusiasm for Nature. He was by no means an insular man, having friends among painters, writers, politicians and scientists. He was extremely fond of modern art and finding in its ambiguity, forms of meaning and thought, he approached it with enthusiasm and joy. It was to him, another challenge to be investigated, another complementary phenomenon which composed his unified world.

> What made his personality so extraordinary was organic unity and dedicated steadiness. His life was not, as is so often with great men, shaped by one or several crises. It was a continuous succession of daily crises: hard struggle moved him through every step. In big or small matters alike, whether they concerned physics, politics, philosophy, verbal or written expression, he always suffered the agony of the struggle for perfection.
>
> (Courant, 1968, pg. 304)

ALBERT EINSTEIN: 1879-1955

Albert Einstein, the physicist whose General Theory of Relativity has contributed perhaps more than any other single factor to our modern conception of the universe, is perhaps better known for his creative genius than any other scientist of the twentieth century. It is some measure of his genius that he was so popularly known and esteemed, even though the theory he developed is difficult for most and impossible for some to comprehend. He represents a revolutionary break from Newtonian mechanics and planted seeds which were to change the entire science of physics, even to a point that he himself could not accept. At the same time, he represents for many, the archetype of the absent-minded, unconventional scientific genius, who, though brilliant in the abstract world, is somewhat naive and awkward in the daylight world of practical living.

Einstein placed his God at the core of his world view. He was not a religious man in the sense of practicing in organized religions, and his God is like Spinoza's -- revealing himself in the harmony of all which exists, but unconcerned with fate and action among men. Einstein's God, "appears as the physical world itself, with its infinitely marvelous structure operating at atomic level with the beauty of a craftsman's wristwatch and at a stellar level with the majesty of a massive cyclotron." (Clark, 1971, pg. 19) His view of Nature, the universe, and God, were thus integrated, and were represented by his belief in an orderly, harmonious system obeying general rules which he spent his mature life trying to uncover. This world view, based as it was on order and harmony at all levels of action, determined two aspects of his approach to science which were the keys to his work -- "the search for a unity behind disparate phenomena and the acceptance of a reality apart from direct visible truth." (Clark, 1971, pg. 52)

In order to understand the true measure of the revolutionary nature of Einstein's thought, as well as the holistic, unified nature of his theory, one must attempt to comprehend both as new patterns of viewing nature, rather than as simple discovery of some facet of Nature. J.J. Thompson, in speaking of Relativity said, "It is not the discovery of an island, but of a whole continent of new scientific ideas," and the Times in London stated, after empirical evidence for the theory had been found, that

> the scientific conception of the fabric of the Universe must be changed. It is confidently believed by the experts that enough has been done to overthrow the certainty of ages, and to require a new philosophy of the universe, a philosophy that will sweep away nearly all that has hitherto been accepted as the axiomatic basis of physical thought.
>
> (Clark, 1971, pg. 227)

Einstein's tacit belief in the unity and harmony of physical laws, as well as his belief that they could be discovered "by those who had the courage and the imagination and the persistence to go on searching for them" (Clark, 1971, pg. 19), determined, to a large extent his modes of thought and approaches to problem-solving. He was capable of deep insight, perceived anomalies, distrusted absolutes and thus was not hindered by traditions or authority in his field. He was unconcerned with details, and worked largely in isolation, not needing stimulus or encouragement from colleagues, and thus, his work illuminates a broad view of specific scientific problems. His holism, or integrated approach to phenomena is best stated by Einstein himself --

"I want to know how God created this world. I am not interested in this or that phenomenon, in the spectrum of this or that element, I want to know his thoughts, the rest is details." (Clark, 1971, pg. 18-19) He strove for a theory which would embrace the entire realm of physical phenomena, ... "A theory is the more impressive the greater the simplicity of its premises is, the more different kinds of things it relates and the more extended is its area of applicability." (Clark, 1971, pg. 109)

His theory, and the methods of thought which contributed to its development, not only demanded the ability to perceive anomalies in previous thought, but also demanded "an intuitive discernment of essentials." (Clark, 1971, pg. 50) Einstein had highly developed observational skills, analytical skills, and agreed that invention, imagination and the intuitive approach played a major and serious role in his work. Responding to a comment from Plesch, his doctor and friend, who had speculated about the role of imagination in scientific work, Einstein replied, "there may be something in what you say. When I examine myself and my methods of thought, I come to the conclusion that the gift of fantasy has meant more to me than my talent for absorbing positive knowledge." (Clark, 1971, pg. 87) Certainly, Einstein's lectures are filled with examples, images and imaginative illustrations of relativity. Much of it may be a response to setting up imaginative situations for himself then applying himself to the theoretical actions of the phenomena involved. In Einstein's mind, men were put in boxes out in space, light was sent through stationary and moving elevators, and such imaginary settings provided him with the stimulus and the framework within which to work out problems of time, space, and gravity.

His focus and powers of concentration were immense, and his mind was constantly immersed in problems of physics. He explained his music as an extension of his thinking process, allowing his subconscious to solve particularly tricky problems. He was known to pause in the middle of dinner, push back the plates and scribble equations on the tablecloth. (Clark, pg. 175) His memory was atrocious concerning anything but physics -- and numerous stories surround his absent-mindedness, unconventional behaviour, impracticality and naivety in day to day living. It seems that he was by far most competent in the abstract universe he had created for himself, and simply refused to concern himself with things that did not matter to him. He could isolate himself from the surrounding trivia of existence with ease, and had little patience with formality, protocol of any kind, or even with the distractions of personal life. Bertrand Russel wrote of him, "Personal matters never occupied more than odd nooks and crannies in his thoughts." (Clark, 1971, pg. 31)

He had no energy to invest in complications of a human kind; he felt "an intuitive sympathy with human beings in the mass, but when it came to individuals -- and he included himself -- he found little time or sympathy of understanding to spare." (Clark, 1971, pg. 31) His first marriage ended in disaster, but relief for Einstein, and his second provided him with peace and order of a maternal type, but with no emotional or intellectual partnership. He needed someone to take care of him, to relieve him of the responsibility of administrating his personal needs, but wanted no distractions from his work, and his close friend Max Born explains that he was totally detached from his environment and the human beings included in it. (Clark, 1971, pg. 532)

He was playful, boyish and maintained a whimsical, quixotic humour and sense of the ridiculous all his life. His humour was often irreverent and delighted his students, with its mischeivious insights and occasional attacks on authority. Einstein had little respect for authority of any kind, was highly independent of it and deliberately trod his path outside of the group, as a loner, and often as a critic of the establishment. In remembering his first taste of religious skepticism he writes --

"Suspicion against every kind of authority grew out of this experience, a skeptical attitude towards the convictions which were alive in any specific social environment -- an attitude which has never again left me, ..." (Schilpp, 1949, pg. 3) His basically dissenting spirit was an advantage to his scientific work, which revolutionized physics, but caused a great deal of difficulty for him when he blundered, and it was indeed a series of blunders, into the social and political realm.

Einstein was a humanist, deeply international, and a pacifist by nature. He was, at the same time, politically naive and boyishly trusting in his belief that political problems could be reduced to the same simple forms that were possible in science. This is not the place to trace either his politicization, or his contradictory emotional responses to the world as he watched it emerge during the first and second World Wars. It is, however, significant that his lucidity of mind and intuition, his cool, unemotional yet deep committment, and his holistic, integrative and harmonious approach when dealing with science, seem to have deserted him completely when he involved himself in the human realm of political and social action. His intentions were pure and unblemished, but his actions were marked with a stumbling naivete and emotional blindness which typify a man out of his depth. So, though he involved himself in both pacifist and Zionist activities, he cannot be seen as politically conscious, but rather as a man with deeply humanistic beliefs, without the competencies or aptitudes to act clearly and consistently upon them. In fact, it was perhaps, the very qualities which made him a genius in physics, his abstraction, his intuitive insight into laws and harmonies of Nature, his total focus upon scientific problems, which prevented him from implementing his good intentions in the social realm. He had neither the time to commit, nor the experience in the human realm, which would have been necessary.

So, though he was holistic in his deep understanding for Nature, he appeared unable to integrate human, political or personal activities into his broad intuitive framework of comprehension. He said of himself -- "I'm not much with people, and I'm not a family man. I want my peace." (Clark, 1971, pg. 18)

OVERVIEW OF COMMONALITIES AMONG THE SCIENTIST SAMPLE

Up to this point, in this Chapter, each of the five scientists has been approached as a separate, holistic individual. It remains for this section to now approach them as a group, drawing attention to common elements which may appear to occur consistently between members of this group. It should be stressed here, as it was earlier in the study, that such comparison as is about to follow, is not an attempt to declare sameness or common identity among the scientist members, but is merely a quest for similarities and commonalities which exist among this group of separate, distinct and unique individuals. The sample members are different men, in different fields of endeavour and for the most part, represent different historical periods. The only highly obvious commonality they share on the surface is their highly creative involvement in some aspect of science. This section attempts to illuminate less obvious commonalities, and to present them in a manner whereby they may later be used to make comparisons with the artistic sample.

Johannes Kepler, Charles Darwin, Albert Einstein, Neils Bohr and Hermann von Helmholtz, between them represent contributions in the fields of astronomy, biology, geology, physics, mathematics, physiology, chemistry, and optics. Though they do not represent the major contributions in all these fields, their diverse interests and involvements in science, provide, at least, a fairly comprehensive and representative sample from scientific history. Even within the variety of their endeavours, lives and periods of history, one may find common elements which might be viewed as characteristic of the group.

The first area in which one may find strong similarities between these men, is that of world view, or consciousness of reality. Each of them maintained a holistic, harmonious view of Nature. In Kepler, it is directed towards the entire universe, as it is in Einstein and Bohr. Darwin and Helmholtz, maintain the same view, but concentrate it more directly on the physical world of Nature. At the same time, basic to this holistic view, is the strong tendency towards integration and synergy of experience and thought. They are relaters and synthesizers, all able to see the inter-relationships and connections between apparently different aspects of the world. This is pronounced especially in Kepler's "Harmonice Mundi," Helmholtz's work on science and aesthetics, Bohr's "complementarity," Einstein's synthesis of wave and particle light theory and Darwin's synthesis of numerous theroetical stances with observational facts to arrive at his theory of evolution. These are but the obvious examples of the integrative viewpoints and abilities of these men, and in fact, all of their major contributions to scientific history may be seen as evidence of their integrative perspective and their skill as synthesizers.

All of these scientists were unreceptive to the traditional views which surrounded them. They were inquiry-oriented, and had few mental sets regarding their work areas which hindered them from posing questions, but rather, were all revolutionary in their questions, and seem to have avoided the mental and perceptual limitations of their contemporaries. All of them except for Kepler maintained a negative or indifferent attitude towards organized religion, yet it would appear that each was highly religious in their love, awe, wonder and fascination for the natural world. Kepler's God, might well be the same as Einstein's, one of order, beauty, and harmony in all living things. Kepler, however, was committed to the Lutheran faith, though he staunchly refused to accept some aspects of even it, and was persecuted for his religion on numerous occasions. Thus, his religiousity, and often mystical bent, does not allow a generalization about the sample's religious leanings. Kepler's steady refusal to accept all aspects of dogma, however, does allow support for the view that all five scientists refused to wholeheartedly accept "organized" religion, as dictated by the church. Darwin was an outright atheist and materialist, Einstein, a Jew who worked for the Zionist cause, but considered himself an unbeliever, whose God had nothing to do with man, and Helmholtz avoided extremes in religion, leaving one with the feeling he maintained the empiricists' curiosity but distrust in metaphysics of any kind.

Though it is impossible to "know" how an individual thinks or approaches problems, since they often cannot "know" themselves -- there seems to be enough evidence to imply certain similarities in this area, amongst the scientists under study. All of the sample members, except Bohr, have left sufficient documentation of some major aspects of their thinking and working process. Bohr, in working as he did with numerous colleagues often in a discursive mode, has at least left the impressions of these colleagues on his method. It seems clear that all these men possessed and utilized to a great degree, highly active imaginations, and a high degree of intuitive insight into the natural world. All give the impression of energetic and continually active minds, able to be focussed with intense concentration and focus, and able to maintain diverse and numerous thought patterns at the same time. Their minds seem to be divergent, connective, and possessed with both the ability to see things in new ways, and the tough-minded determination and logic to work out problems of great magnitude and complexity. All were concerned with the relationship between theory and observable fact, and all seem driven by a common love of Nature and search for truth.

A major element in their creative insight and behaviour may lie in their common acceptance of novelty, change, and their willingness to risk. None of them seemed bound by perceptual sets. Though insight, even sudden leaps, played a definite role in their thinking processes, all seem to have been in a position to recognize and utilize such insight, through long and complex involvement with the problem. Their minds were welcoming and open. "The way is made ready by active search and inquiry. The welcoming mind belongs to one who has prepared it by his own efforts ... as a field in which new ideas can flower." (Gruber, 1974, pg. 247-48)

Two other factors, common to the group, may illuminate contributions to their creative processes. All of them were highly playful individuals, and all had major emotional investments in their work. Though play behaviour takes different forms, and manifests itself to different degrees in each of these individuals, it is, nevertheless a common factor. Bohr's stone-throwing and gun-fighting interests, Helmholtz's play-acting and odds-and-ends constructions, Kepler's cup, science-fiction fantasy and play with symbols of geometry, Einstein's sailing, whimsical play with children and unconventional social behaviour, and Darwin's mischeivious trick of hiding on Huxley, and his sometimes playful experimental work, all provide indications of the involvement of these scientists in play behaviour of one type or another.

In many ways, their experimental work can be viewed as play in a practical sense and their theoretical manipulations, as play in the symbolic realm. All were filled with great enthusiasm and exuberance about their work, and their explorations of the natural world. Their deep love of science and Nature was matched by their seemingly youthful delight in learning its secrets. It is interesting to note that their emotional expenditure on their work was often unmatched in the personal realm.

All of the individuals in this sample were married and though there seems a range of differences in their emotional relationships in the personal realm, one point, and only one, emerges as common to all. This is the common tendency in all, to avoid personal conflict and emotional upheaval. The means by which each individual achieved this harmony in their personal life varies radically from one to the other. Einstein divorced one wife and married another who provided a harmonious personal background and dealt with the domestic practicalities which he had no wish to worry about. Darwin and Bohr married and maintained long and harmonious relationships which provided them with stability in their personal lives, so that their focus upon work was not distracted. Kepler and Von Helmholtz both remarried after their first wife's death for the companionship and stability they needed to maintain emotional focus on their work. In none of the personal relationships of these men, do we find great passion, intensity or upheaval. If upheaval arises, it is quickly resolved or avoided, and the common need for harmony or lack of personal conflict rises as the most important shared element in their personal relationships. All of them needed solitary time, undistracted by social demands, to invest in their work, which was central in the priorities of them all. Socially, however, there is little commonality beyond that need. Though none of them were ubiquitous social butterflies, some, like Bohr and Helmholtz, were quite at home in social gatherings, both having active households with stimulating and fairly regular interaction socially. Kepler and Einstein, were more negative and anti-social, and Darwin, though he enjoyed the society of friends and family, led a quiet, country life, with little interaction with the scientific society in London at the time.

All of these scientists had little respect for authority. It is obvious from their revolutionary contributions to science that they were not overly impressed or effected by the established scientific authorities of their time, since each in their own way, not only rebelled against them, but, in some cases overturned them completely.

Kepler, in supporting Copernicus and in his religious pig-headedness, showed little respect for either the prevailing authority in science or the Church. Darwin, the atheist, the materialist, the evolutionist, locked horns with authority in both science and religion, the effects of which may still be seen in contemporary debates. Einstein, was skeptical of all authority, Bohr, though not as cynical, either questioned or ignored it, and never used his own to gain ends, while von Helmholtz, rejected the authoritative metaphysical roots of 19th century science with calm equanimity and disregard.

Aside from their common tendency to be skeptical of authority, there is no other general tendency towards unconventional behaviour in this group. This is not to say that Kepler, Einstein, and Bohr were not unconventional, for indeed they were in many ways. However, von Helmholtz and Darwin both seem, though highly creative and original in thought and behaviour, less prone to deviate from the social norms of their day.

The final element for examination remains the social or political consciousness of these men. Though all are particularly humanistic and "liberal" in their view, there does not appear to be a general common trend towards involvement or non-involvement in the real socio-political realm. Ideologically, they are similar, and though there is a small tendency towards non-involvement, Bohr and Einstein both became involved actively in attempting to implement some of their humanist ideals, though somewhat naively. It would seem that all were of pacifist leanings, internationalistic rather than nationalistic, and found curtailment of freedom, and violence, strongly distasteful. No further generalization, however, can be made about their views in this area as their actions, or non-actions, remain quite different.

A few final points remain. All of the scientists in this group were strongly process-oriented, none viewing any single piece of work as complete, finished or perfect. All constantly revised their work, and with the exception of Einstein, late in life, remained open to new ideas and discoveries. All were learners of the highest degree, highly curious and aware of the amount they did not know. All integrated the ability for well-functioning, intensely hard work and patience, with a high-degree of intuition, imagination and spontanaeity. And finally, all of these men, Kepler, Darwin, Helmholtz, Bohr and Einstein, placed the search for truth and a profound love of science and Nature at the centre of their lives.

CHAPTER FIVE

THE ARTISTS

INTRODUCTION

This Chapter presents the descriptive data on the sample members drawn from the Visual Arts. As in the preceding Chapter, the morphogenic descriptions are organized around the five broad points of reference outlined in Chapter Three. [i.e. (1) Modes of Thought (2) World View (3) Creativity (4) Social Interaction (5) Social Consciousness.] Similar limitations of depth and scope apply to the biographical treatment of the artistic sample as applied to the scientific sample, and the reader is once again reminded that the descriptive data presented here is neither exhaustive nor highly detailed.

There is in this Chapter as in the preceding one, the necessary use of somewhat technical language and specialized concepts, belonging to the field of aesthetics, art history and art criticism. As in Chapter Four, sources where the reader will find a fuller treatment of aesthetic and art historical issues which lie outside the scope of this study, are provided in the bibliography.

One further and final issue should be mentioned at this point. As was the case with the scientific sample, the selection of the five artists examined in this study, was a difficult and often frustrating task. Many artists whose lives are documented amply have been excluded, some of whom might seem particularly suitable to the search for commonalities. Such men as Constable, Turner, Walter Gropius, Mondrian, Paul Seurat, and of course da Vinci, immediately come to mind as artists with obvious "scientific" leanings, and the reader might wonder why they are not members of the selected sample. The primary justification for their ommission lies, in fact, in the very obvious "scientific" nature of some of their involvements. It is not the purpose of this study to establish commonalities which rest on superficial, or surface likenesses in interest, endeavour or behaviour, and certainly, to assume commonality based on exhibited interest in science by an artist, or the love of music or painting by a scientist, does not appear sufficient. It is, then, not the "art" or the "science" of the individual's life that is of prime importance here, but rather his involvement with it in terms of his life, his approach to that life, and his use of it through work, play, in thought, creation and in interaction with others.

It would indeed, be a simple case to use a Leonardo da Vinci to show parallel artistic and scientific thought; integrated thinking and versatile creative powers. The temptation, however, to "load the dice" so to speak, with "scientific" artists, or, on the other hand, "artistic" scientists, is one which should be avoided at all costs, even at the cost of ommitting such diverse and well-known personalities.

In addition to this, it is important to establish commonalities which run at a deeper level, not merely at the level of action, which might be obscured by the more obvious and immediate likenesses. For this reason, and the equally important one that the sample is limited to five members only, certain artists have, through necessity been excluded. It should, however, remain obvious, that art history has provided us with a vast number of highly creative innovators who could have been included equally well in the sample.

No attempt has been made here to illuminate the complex art historical contexts from which the individual artists emerge, except where such illumination is necessary to establish a point of character or personality. The history of art, as the history of science, is long and complex, and the predominance of influences, eclecticism and creative synthesis of ideas and styles is so great that to embark here on a lengthy exploration of the influences under which each of the sample artists worked, would be both out of place and a burden to the reader. Such information is available elsewhere, and where relevant, further and more detailed sources are cited.

It is, then, with these points in mind, that the remainder of this Chapter presents descriptions of Leon Battista Alberti, Eugene Delacroix, William Morris, Paul Cezanne and Pablo Ruiz Picasso. As in the preceding Chapter, these morphogenic descriptions are followed by a concluding overview of the commonalities within the artistic sample.

LEON BATTISTA ALBERTI: 1404-1472

Leon Battista Alberti has been called the "Florentine Vitruvius," by both his seventeenth century biographer and by Rabelais. He is described by Giorgio Vasari, the Renaissance biographer and writer on the arts as an "Architect of Florence" (Vasari, 1946, pg. 346), and is primarily known for his writings on architecture, art and perspective. The Tempio Malatestiano, the facades for Santa Maria Novella and the Palazzo Rucellai, and the Churches at San Sebastiano and that of Sant' Andrea, established Alberti "as a major architect, a worthy successor of his friend Brunelleschi." (Gadol, 1969, pg. 8) Erwin Panofsky, the noted scholar in both art history and iconography, showed in his writings on this period, "that Alberti's systems of perspective and human proportions constituted the technical foundations of Renaissance painting and sculpture, introducing into these arts ideas and values which had far-reaching cultural implications for the age." (Gadol, 1969, pg. 14)

It would seem, then, that as both an architect and a theoretician in painting and sculpture, Alberti was esteemed within and beyond his time as a major creative personality. Very little of the personal life and events which normally contribute to a biographical picture of an individual, are known or recorded in Alberti's case, yet his contemporaries and the vast body of his work provide significant clues to his character. At the same time as it contributes to the clarification of the man, Alberti's works display such a vast and varied accomplishment, that one quickly realizes that his creative contributions go beyond the boundaries of architecture, painting and sculpture. Although he stands, forthe purposes here, as an artist, architect, and art theorist, some of his work in other areas further reinforces and illuminates points regarding his thought and character, and thus is better explored than ignored.

Throughout the body of Alberti's writings and practical works, in areas as diverse as painting, cryptography, surveying and architecture, run unifying concepts which exemplify the inner logic and coherency of his broad world view or concept of reality. These concepts, or aspects of his world view, provide the core of his artistic, technical, scientific and humanistic works and provide us with the essence and intent of intellectual character and his personality. They are measure, harmony and proportion, and they point towards "a systematic unity that underlies and adequately explains the diversity of his many achievements." (Gadol, 1969, pg. 19)

Alberti believed strongly and consistently in a lawful, harmonious world order and saw no dichotomy or discontinuity between his artistic and technical-scientific work. He saw them rather as different aspects of a single pursuit, alternate views of the same vision. This holistic and harmonious world view is best demonstrated in the body of Alberti's work, and provides as well, the basis for his integrative mode of thought. "Della Pittura," his treatise on painting finished in 1436, was the first systematic exposition of painter's perspective. It is also the first written exposition, and basically it synthesizes visual experience and geometric representation into a comprehensive, mathematically based theory of representational painting. In it, Alberti posed himself the problem of finding correct rules of construction for three-dimensional illusionary space in painting. By relating previous theories of perspective, which were concerned only with optics and vision, to painting and drawing, and further, by relating both to the system projective geometry, he not only achieved a novel and unheard of synthesis, but at the same time laid the foundations for a revolution in artistic spatial depiction which had crucial significance for the future of European art. Gadol describes the consequences:

> But this artistic revolution, significant as it was for the future of European art, was not the sole consequence of the union of geometry, vision and depiction brought about by painter's perspective. At the same time as the mathematically inspired concept of perspectival space began to appear in art, the actual, physical image of the world came to be conceived as ordered in accordance with mathematical principles. The old Euclidean science was understood in a new light and put to new uses; and the new grasp of the principles of geometry, together with their application to problems of depiction, worked, in turn, to transform man's imaginative and theoretical vision of the world.
>
> With the perspectival ordering of pictorial space, we stand, therefore, at the very threshold of the imaginative and intellectual world order we call Renaissance. Painters perspective opened not merely a new phase in the practice and theory of the visual arts, but a new age in which reality came to be viewed and understood in mathematical terms.
>
> (1969, pg. 21)

Thus, aside from the unified and synergic nature of Alberti's vision in "Della Pittura," one sees that it was a novel and revolutionary insight which integrated art and geometry and optics into the theory and rules of painter's perspective. It illustrates as well, Alberti's singular belief in a lawful, harmonious world order in which visual reality could be systematically ordered in mathematical terms. This idea or concept of harmony and proportion in reality or nature was by no means new. It is essentially as classical in nature as Euclid himself, and it might be seen as an example of Renaissance pre-occupation and restoration of classical ideals and concepts. Classical conceptions of artistic space were based on geometrical ideals of proportion and harmony, and Alberti's spatial conceptions were an echo of the same aesthetic outlook and a similar view of harmonious world order. Perspective, however, was not a restored or revived ideal, but rather an

> independent expression of an aesthetic outlook which had originally given rise to the proportional art of antiquity. It had no direct connection with classical art, but as it imposed its proportional spatial order upon painting, it inevitably brought about a classical mode of construing appearances.
> (Gadol, 1960, pg. 56)

Thus, Alberti, holding on to a world view which was parallel, if not identical to the classical idea of harmony and proportion and order, introduced an independent innovation, which was coherent with the classical revival of his period.

"Della Pittura" stands as an example of Alberti's world view as well as of his modes of thought. No one before him had set out such an unlikely union or series of relationships, and it seems evident that his belief in harmony and unity, thus enabled him to see and apply connections and relationships where those before him had seen none. His work continues throughout his life to follow the integrative pattern set by "Della Pittura."

In "Della Statua," he turned to sculpture, and again applied to art, ideas and concepts which belonged to geometric mapping and surveying. In this instance, he also made use of the exact tools and instruments which he had developed and used to map the city of Rome. Lack of space does not permit a full illumination of all of Alberti's works, so it will suffice to say that "Della Statua" provided the sculptor with geometric guidelines for measure and proportion in his work from Nature, just as "Della Pittura" had provided painters with perspectival construction of three-dimensional space. One further point about "Della Statua" should be made in regard to the position of its author on traditional medieval systems of proportions. Alberti rejected the mystical traditions of the Middle Ages which used the head as the unit of measure, detached himself from the metaphysical objectives of such systems and used the foot of his six foot exempeda system as an arbitrary, qualitatively neutral measure. He was not concerned with metaphysics or religion to any degree which influenced his empirical approach to the realities of Nature, and thus we see him, without the traditional, intellectual sets which had dominated proportional systems throughout the Middle Ages.

Throughout his writings on art, Alberti pursues and promotes the ideal of congruity of parts and harmonious proportions throughout the whole. In painting, he placed emphasis on composition, on the order of the whole and on relationship among components. His entire definition of proportional unity promoted a systematic and integrated rather than aggregate whole. No where else in his work is this belief in holistic and harmonious unity exhibited more than in his great work on architecture, "De re aedificatoria" (1452). It was in this work that "his theory of art, and the art theory of the Renaissance became fully explicit and revealed in its distinct features." (Gadol, 1969, pg. 104) This work, written in ten books, certainly cannot be analysed in depth here, but due to its significance both in indicating aspects of Alberti's thought and character, and in it's place in Renaissance art theory, it must be considered one of the most important of his works. In it, Alberti used the mathematical conception of artistic form to bridge the differing ideas of symbolical imitation and empirical truth in art.

> Between the two, between the Platonic idea of art as a sensible copy of phenomenon and the Neo-Platonic idea of art as a symbol of transcendent realities, the mathematical conception of artistic form now provided a bridge. By focussing on proportions, upon a reality that was at once natural and ideal, Alberti made explicit what classical art, in fact, had sought; and thus he brought the theory of imitation to a new stage. The Renaissance owes to his theory of architecture, its novel conception of art as symbolizing by direct embodiment the purely structural form of phenomenal reality.
>
> (Gadol, 1969, pg. 104)

In "De re aedificatoria," Alberti sees a building in the same way he saw the human body in "Della Statua." It is an example of his unified vision that the unity, harmony and proportion of the human form, manifest themselves for Alberti in the form of a building as well. His theory of architecture is based on "Numerus," "Finitio" and "Collocatio;" the number, the measure, the arrangement of parts. The concept of measure, "finitio," is most highly stressed and Alberti related proportional measures in architecture to the harmonic ratios of music. The Greek system of musical harmonies, [i.e., 2:3 (a fifth, 3:4 (a fourth), 1:2 (an octave), etc.] was the basis which Alberti suggested architects use for the proportional system of their buildings. As fanciful as this may sound to some, the facade designed by Alberti for the medieval church of Santa Maria Novella in Florence, makes perfectly clear his aesthetic intentions, and his ability to translate theory into practice. It is a masterpiece of dimensions all bound and unified by the 1:2 ratio of the musical octave and Wittkower, (1962), the noted Renaissance art historian has called it a great "Renaissance exponent of classical eurhythmia ..." (pg. 41-47)

Aside from the unification of theory and practice which may be seen in Alberti's architecture, "De re aedificatoria" stands as a further indication that his thought did not remain in the realm of intellectual theorizing alone. It is filled with practical and technical knowledge of building, and contains surprisingly contemporary knowledge of the most recent devices and procedures. His writings, as well as his practice as an architect and engineer indicate his consistently integrated approach to everything he did. His practical work in surveying and map-making was complemented by a treatise on the subject, "Descriptio Urbis Romae," as well as by the invention of instruments to measure bearings for map-making. His own practical experiences as a painter and sculptor had been complemented by "Della Pittura" and "Della Statua." His experiments in practical surveying and geometry were complemented by "Ludi Mathematica," a book of mathematical puzzles, games and problems. He applied mathematical principles to cryptography when asked for his ideas on coding by a papal secretary, and in addition to devising an "extremely secret and convenient method of writing," he constructed a coding disk and wrote a treatise on it which stands as "the first modern work on cryptography." (Gadol, 1969, pg. 207)

> Alberti consistently fused practice and literary learning, whether in painting, surveying, cartography, or in architecture and engineering; and this meant that not only as a scholar and a man of letters he wrote about the manual arts, but that he, himself had mastered and practiced with considerable skill the arts he described.
> (Gadol, 1969, pg. 203)

Thus, it becomes clearer, that above all, Alberti's holistic, integrative and synergic mode of thought, combining theory and practice, relating elements which had not been related before, and unifying concepts throughout diverse fields, provided him with the tools with which to view the world. Gadol sums it up in the following way:

> The same few intellectual steps led him to revise and revamp traditional methods in fields as diverse as painting, sculpture, architecture, cartography, surveying and cryptography. The assumption of a rational order in all parts of the world, within themselves and with respect to each other, underlay his theoretical vision in each case, and in each case it was this order

> which he strove to find.
> (1969, pg. 211)

In the realm of religion, Alberti appears to have avoided both the medieval extremes of astrology and the Neo-Platonic philosophy of contemplation and transcendence. There is little in Alberti's writings which implies a sincerely religious mind, and in view of his pursuit of an active and intellectual life, one does not find this surprising. He did not advocate astrology, which was still highly esteemed during his age, but neither did he reject it outright. Rather, he tolerated it with the practical sense and openness of mind which typified his works and writings. "Following their instructions may be of great service if true, and can do little harm if false." (De re aedificatoria, Bk. 2, Ch. 8). He avoided metaphysical and philosophical speculation, argued against passivity and reliance on prayer and basically placed man in central responsibility for his own life and deeds.

Alberti's social views emerge as strongly humanist in his writings on moral philosophy. Aside from stressing daily urban life and moral action, they stand as a break from tradition in a formalistic sense as well. He was strongly criticized for deviating from the traditional Latin prose of his time (at which he was a master) and for introducing and utilizing the Tuscan vernacular for serious prose. The authority of Latin was unquestioned in fifteenth century Italy, and Alberti's conscious break from an academic and social norm was perhaps instrumental in the rise of respect and use of the vernacular which was to follow. He wrote in "I primi tre libri della familglia" in defense of his break with tradition.

> Who will be so rash as to blame for not writing in the manner he would like me to write? Rather, the prudent will perhaps praise me if, writing so that everyone can understand me, I seek to help the many rather than please the few: for you know how few literati there are these days.
> (Gadol, 1969, pg. 232)

About Alberti's personal life, there is little available record. That he remained unmarried and dedicated his time and energy to his various works, seeking harmony in both theory and practice, might indicate that his social interactions provided no distractions, and was most likely typified by the harmony which emerges through his work.

His practical inventions, as well as his theoretical and humanistic works, illuminate his integration of the experiential and the intellectual aspects of life. His overwhelming curiosity led him to inquiry and practice of the most diverse fields, and he often was seen in the streets and markets of Florence and Rome, conversing with smiths, architects, sailors and craftsmen, inquiring into their skills and trade. His writings contain "in point of fact, the most advanced technical knowledge of his day on an astonishing variety of topics." (Gadol, 1969, pg. 203)

It becomes clear then, through Alberti's works, both practical and theoretical, in painting, sculpture, architecture, cartography, mathematics, surveying, cryptography and the writing of prose that he lived up to and perhaps even surpassed his own conviction that "nothing is too difficult for study and determination to overcome." (Gadol, 1969, pg. 107)

EUGENE DELACROIX: 1798-1863

Eugene Delacroix is considered by most art historians as the revolutionary founder and greatest proponent of the Romantic movement in nineteenth century French painting. He has been described by John Canaday (1969) as "the standard-bearer of romantic painting in France" and as its "international god-head." (pg. 793) Baudelaire called him a "complete man of genius," "one of the chosen few," possessed of an "ever-incandescent imagination" and a "ceaseless preoccupation" with his art. (1947) Upon his death in 1863, Delacroix left behind him more than a thousand paintings, double that amount of water colors and pastels and over nine thousand drawings, in addition to numerous essays on art and his "Journal" which is "one of the great testaments in the history of art." (Canaday, 1969, pg. 794) It is, indeed, through the "Journal," more than any where else, that Delacrois reveals himself to the interested observer. His outer character, his social self, his painting and his romanticism are well described and documented by his friend and contemporary, Baudelaire. It is in his "Journal," however, and in his vast correspondence, where his thoughts on art, on life and on himself become explicit. It reveals him as a man of diverse interests, with a deep, holistic love of Nature, a passionate commitment to his work, and an intuitive ability to relate and synthesize seemingly disparate ideas and actions and observations.

> Eugene Delacroix was not only an artist in love
> with his craft. He was also a man of broad

> general culture, in contrast to other modern artists, most of whom are little more than famous or obscure daubers, sad specialists and pure craftsmen, some able to paint academic figures, others fruit and still others, animals. Eugene Delacroix loved everything, could paint everything, appreciated all kinds of talents. His mind was open to all ideas and impressions: He enjoyed them in the most eclectic and impartial manner.
> (Baudelaire, 1947, pg. 16)

The overwhelming evidence of both the "Journal" and of his work itself, illuminate Delacroix's world view as preoccupied with the quest for unity. "Happiness for Delacroix was a question of balance and expansion within." (Huyghe, 1963, pg. 21) Thus, Delacroix appears consistently as a learner, constantly seeking improvement, knowledge, and deeper understanding in addition to his strong tendency to seek unity and relationship between the various facets of his learning. "It is the feeling for unity and the power to realize it in the work which makes the great writer and artist." (Delacroix, Nov. 20, 1857) His painting stands as a supreme example of his unifying vision of the world; and aside from aesthetic concerns with compositional unity, he was revolutionary in his subjugation of pictorial detail in favor of emphasis on the generalized whole. His approach to painting, and the works themselves provide a rich example, was synthetic, mobile, integrative; he sought "an all-embracing vision proceeding from the whole to the details in absolute contradiction to the dry method that starts from outlines and reaches the whole by a juxtaposition of parts." (Huyghe, 1963, pg. 115)

Perhaps even more indicative of his questing and unifying mind, was his eclecticism in painting.

> Delacroix did not consider that the artist should or could start from nothing; his imagination looked for support to the data supplied it, whether by nature (which speaks to the eyes), by work of writers (which speaks to the mind), or by the paintings of earlier masters, (which address themselves to both).
>
> (Huyghe, 1963, pg. 373)

The influences and sources of inspiration which Delacroix sought and drew from for his work, were broad and varied and ranged from past to present. Seeing the work of Constable stimulated the in-depth and continuous research on colour which Delacroix continued throughout his life. He drew subjects and inspiration from Shakespeare, Byron, Dante, Ariosto, classical history, contemporary politics, religion, the Orient and from Nature. He was influenced strongly by artists as diverse as Gericault, Poussin, Reubens, Veronese and Velasquez. In the Journal of 1824, he wrote "Ah! what would be strange and really beautiful would be to unite the styles of Michelangelo and Velasquez." (April 11, 1824) Such influences, rather than dominating style or idea in Delacroix's painting, were spurs to action, an impetus for thought, and served mainly as nourishment for a mind which was continuously seeking stimulus for enrichment and challenge. The mere idea of a union between the great Italian Renaissance master and the Baroque Spaniard indicates the novelty of Delacroix's thought, his ability to juxtapose rarely connected phenomena.

One sees his connective mind at work in his Journal and notebooks as well. His entries on Nature, as well as exposing a deep love and delight in the natural world, are meticulous in their descriptive detail, colour notations and insight. They give the reader the impression of a student's or naturalist's approach to the physical world. He often spoke of Nature to Baudelaire as a "Dictionary" and consistently integrated his observations, especially in terms of color and light, into his paintings. Indeed, not only his notes on Nature expose Delacroix as a constant student and impulsive learner, but his approach to literature, theatre, music, color, classical art and history, and science reinforce his curiosity, his openness to ideas, and his remarkable ability to relate and integrate knowledge gained. Indeed he might have been describing himself when he wrote in his Journal in 1824:

> ... I think it is imagination alone, or better still, what amounts to the same thing, that delicacy of the organs that makes one see what others do not see, and which makes one see in a different way ...
> (April 27, 1824)

It was with this "delicacy of the organs" that Delacroix viewed his world, his environment in both Paris and in the country house at Chomprosay, and inevitably, his art.

He spent a considerable amount of time in the country, though he lived permanently in Paris, and it is his Journal entries while at Chomprosay or elsewhere in the rural setting, which give a true picture of his deep love for Nature. He observed it with a sharp and loving eye and was sensually delighted by its beauty and complexity. The Journal is filled with passages such as the following: "... the rain had made all the fresh green things smell delicious; the stars brilliant and above all, that fragrance!" (Aug. 12, 1858)

"I made some enchanting discoveries, rocks and woods and above of all, water -- water of which one cannot grow tired. One feels a continual longing to plunge into it, to be a bird, to be a tree with roots steeped in it ..." (July 14, 1858) "I come upon a slug marked exactly like a panther: broad rings on its back and flanks, becoming spots and points at the head and near the belly, which is light in colour, as in quadropeds." (Oct. 15, 1856)

Delacroix's acute sense of observation is outstanding in itself, but the fact that he records, meticulously and with great regularity, such details that he finds in Nature, indicates their importance and relevance to him. In addition to simple observed phenomena, descriptions of battles between ants and beetles, great black flies and spiders, flora, fauna, weather and light characteristics, Delacroix's entries in the Journal regarding Nature include probing analysis, and the search for relationships. He finds Nature "singularly consistent with herself" (Aug. 5, 1854) and discovers, notes and delights in the echoing forms and congruent patterns which he finds there.

During his adult life, Delacroix wrote a great deal on the subject of art, imagination and the aims and methods of painting. He intended to write and publish a dictionary of the Fine Arts, compiling his thoughts on technical and aesthetic issues concerning the artist. Though he never completed it, his "Journal" contains hundreds of notes on the subject, entered with the intention of organizing them at a later date, and from these notes, Delacroix's own methods of creation and modes of thought become clear. Work was his life, he saturated himself with it, loved it passionately and dedicated himself to it exclusively. He wrote of it, as solace, as addiction, as prime stimulant, as passion and as his sole and only love.

> I go to my work as other men rush to their mistress, and when I leave it I take with me into the solitude of my home, or into the midst of distractions I go in search of, a delightful memory that has little resemblance to the lover's uneasy pleasure.
> (Delacroix, Nov. 30, 1853)

He invested great emotional energy into his work and would often paint as if in a frenzy of intoxication. This image of the passionate, emotional Romantic, must be handled carefully, however, for his work was not improvised but highly researched and meticulously planned in advance. Walter Pach (1948) states: "Instead of being an improvisor, as was frequently asserted, he planned his work so thoroughly that when he came to the final execution, he brushed it in with the seeming impetuosity of a sketch." (pg. 19), and the countless studies he did before painting attests to this fact.

Imagination was the paramount quality for Delacroix and he is a curious blend of that quality and reason. "... In spite of my desire to systematize, I shall always be swept along by instinct ..." (March 14, 1847) he writes and yet he submits his "instinct" to aesthetic and intellectual discipline and control. He attains a balance, a complementarity of the "maturity" and the "fire" he sees the need for in painting. For him, painting demanded "erudition like that of the composer and execution like that of the violinist." (Delacroix, Sept. 18, 1847) He believed that the great artist "concentrates interest by suppressing details that are useless or repellant or foolish; and his powerful hand disposes and establishes, adds or suppresses and thus makes its own use of the objects which are its own ..." (Apr. 28, 1854) He was, then, a selector, a greatly inspired one, and in describing his own intellectual methods he writes in 1849, "As to my mind ... it has sureness and the faculty of combining and expressing ..." (Oct. 19) It is the method of combining and relating which rises above all other aspects of Delacroix's painting and thought. His continual comparisons and parallels of painting and poetry, painting and theatre, and even art and science illuminate a mind overwhelmed by relationships, connections and combinations. Following a discussion with Chopin on the "science" of music, he recorded in the "Journal" his positive feeling of excitement ...

> That feeling gave me an idea of the pleasure that is experienced by philosophers worthy of the name. The thing is that true science is not what is ordinarily understood under that term, that is to say a department of knowledge which differs from art. No, science, looked upon in the way I mean, demonstrated by a man like Chopin, is art itself, and obversely, art is no longer what the vulgar think it to be, that is, some sort of inspiration which comes from no where, which proceeds by chance and presents no more than the picturesque externals of things. It is reason itself, adorned by genius, but following a necessary course and encompassed by higher laws.
> (Apr. 7, 1849)

A further aspect of Delacroix's approach to creation was his openness to novelty, change and innovation. He was without a doubt, the great revolutionary of his generation in the field of painting and was little impressed by recent tradition. He broke unequivocally from the academic standards of reigning Neo-Classicism, and remained untouched by the scathing criticism and lack of acceptance which accompanied it. He was quite aware that his paintings were unfashionable but was convinced that he must paint as he chose. He was convinced that the great painter must risk criticism if he was to impart to the viewer a greater vision of Nature and life.

> Thou who knowest there is always something new, show it to them in that which they have disregarded. Make them believe they have never heard of the nightingale or the vast ocean, and everything that their gross senses try to feel only when others have first taken the trouble of feeling it all for them ...
>
> (Delacroix, May 14, 1824)

He was unafraid of newness, relished it and as a continuous learner, embraced novelty with a certain vigour, though not simply for its own sake. In 1855, when the English painters at the L'Exposition Universelle in Paris, shocked and outraged the Paris critics, Delacroix was fascinated and impressed by their skill, even though the Pre-Raphealite painting was radically different from his own. When, in the years following its discovery in 1839, photography met with the contempt and general rejection of the painters, Delacroix remained one of the few who saw it as a great source of learning for the artist, a means for further study of Nature. In 1849 he wrote, "Man is always beginning everything anew, even in his own life. He cannot stop the forward movement of things." (April 4, 1849) He emerges, then, as a highly energetic man who was open to stimulus from broad and various sources, constantly growing and searching out new knowledge from stimuli as diverse as Edgar Allan Poe and Johannes Kepler.

In the personal realm, Delacroix was less open to stimulus. Though he had been somewhat of a libertine in his youth, he steadily withdrew from society and interaction with people to immerse himself in his work. Countless entries in his "Journal" note his necessity for solitude and his continuous avoidance of the distractions of society. Such passages as "I prefer to converse with things rather than men; men are tiresome, their obsessions etc. The work is worth more than the man." (Oct. 23, 1852) and "I must return to solitude. How is one to retain one's enthusiasm about anything when one is at all times at the mercy of other people ..." (Mar. 31, 1824) are representative of his entries on solitude. Personal relationships had disillusioned him in his youth, and though he longed at times for intimacy, he grew impatient and disenchanted with the difficulties involved in finding any deep and meaningful relationship.

> It is one of the greatest calamities that one can never be known or sensed completely by one and the same man; and when I think of it, I believe that here is the sovereign evil of life ... it is this inevitable loneliness to which the heart is doomed.
>
> (Delacroix, June 9, 1823)

It was this complete knowing that Delacroix wanted and never found. His deepest relationships were friendships, like those with

Chopin and George Sand, but he remained essentially a solitary figure, his work precluding any interference.

He did not, even though a revolutionary in painting, enjoy or court conflict in the social sphere. On the occasions when he did enter into society, he was the picture of aristocratic aloofness, impeccable manner, bearing and appearance. The norms he broke were artistic and intellectual, not social, and he remained, until his death, at least on the surface, the picture of bourgeois respectability. Here we find his attitudes towards authority somewhat ambivalent. On the one hand, is the dapper, bourgeois, respectable man of the world, who applied eight times for membership to L'Academie des Beaux-Arts, that ivory tower of traditional French painting; and on the other, is the stubborn, solitary revolutionary painter who refused to alter or manipulate his work according to convention, even to gain the praise and acceptance he longed for. Baudelaire describes this ambivalence between the private painter and the public gentleman as "a volcanic crater concealed beneath bouquets of flowers." (Baudelaire, 1947, pg. 860) His social behaviour then, was far from unconventional, and in his mature years he abandoned society almost completely. He wrote about Michelangelo a statement that might have described himself as well -- "He felt compelled to appeal to men's imaginations even when he avoided their company." (Jan. 16, 1860) Rene Huyghe (1963), the noted art historian and biographer of Delacroix summarizes concisely the social behaviour of the great painter:

> Loosening the bonds of society, friendship or passion which had threatened to tie him to other people, and escaping behind an affable politeness, Delacroix contrived for himself frequent periods of withdrawal, in which he could return to his silent dialogue with things ... he sought to immerse his own (body) in living contact with the natural life of plants, animals and the elements.
> (pg. 25)

It was indeed, in his escape of social distractions, both through his work and in contact with Nature, that one sees Delacroix at his happiest. Even at the age of sixty, he found such contentments, and recorded them in the "Journal;"

> Went out in the country at six o'clock in the morning -- brought home a great bunch of water lilies and bullrushes; I spent nearly an hour paddling about on the slippery clay banks of the river and hugely enjoyed capturing those poor flowers.
> (Aug. 12, 1858)

Delacroix was neither religiously nor politically committed in an active sense, though he had strong opinions in both realms. It must be remembered that he had been brought up with a classical education, a progeny of the rational and skeptical eighteenth century, "Which had attempted to substitute the lights of reason for those of heaven." (Huyghe, 1963, pg. 23) He was skeptical enough to refuse last rites while on his deathbed and to mutter to the doctor who had suggested them to stop this "play-acting." Delacroix, with his continual quest for learning did believe in improvement towards perfectability in man, but saw it within man rather than external to him: "God is within us: the inner presence that causes us to admire the beautiful, that makes us joyful when we have done well and consoles us for not sharing in the happiness of the wicked." (Oct.12, 1862)

In the realm of the social and political changes which were sweeping France during his lifetime he was skeptical as well, being unimpressed by governmental changes or progress and more concerned with human ones.

> Man is making progress in all directions; he is mastering matter, there can be no question, but he is not learning to control himself. By all means build railways and telegraphs, cross continents and the oceans in the twinkling of an eye, but also steer the passions as you steer your aircraft: above all, abolish the evil passions, which have not lost their detestable power over men's hearts in spite of the liberal and brotherly maxims of our time.
>
> (Delacroix, May 22, 1853)

Delacroix was deeply concerned by mechanization and the growing industrial society which was slowly leading people away from Nature, and was opposed to the degradation and coldness of the factory society. He objected to the loss of individuality and to the upheaval from Nature which the "progress" of mechanization offered to those who left the land for the factory. In his politics, if not in his painting, Delacroix was a Romantic, anti-mechanistic, and pro-Nature. He has often been considered revolutionary politically as well as artistically, because of his famous painting which marked the 1830 Revolution and fall of the Empire, "Liberty Leading the People." There is no doubt that Delacroix's sympathy was on the side of liberty and the people, but there exists a good deal of doubt as to how deep or active his sympathy was. His "Journal" does not present him as "egalitarian" in any sense, but rather as quite aware of his own superiority, and "Liberty" is most likely more a statement of faith in the future of France, an allegorical statement on universal liberty, than a direct, personal support of the proletariat. In fact, he was far more individualistic than collective and he stated his views to George Sand in 1848 as follows --.

> The liberty bought by battles is not really liberty, which consists of coming and going in peace, pursuing one's thoughts and so on ...
>
> People are always talking about liberty, it is the cherished aim of all revolutions but they don't tell us what liberty is ... Political liberty is the great phrase used, in fact, to justify the sacrifice of the most real liberty there is, that of the mind, that of the soul.
> (May 28, 1848)

Thus, one finds that in religion and in politics Delacroix remained an individual, abstaining from collective involvement in either as he did in the personal realm. A letter to his old friend Soulier five years before his death, sums up quite clearly the essence of the man and the painter who has been called the father of modern art:

> I have not even the common distractions of ordinary people to divert me ... I have given these up entirely, and I often spend my evenings by my fireside. My illusions drop away one after the other, and only one remains, -- or rather it isn't an illusion, it is a real pleasure, it is the only one without any mixture of bitterness or regret; I mean work. But indeed this is my only passion. May it last longer than all the others.
> (Huyghe, 1963, pg. 29)

Work was his life; it gave him the outlet for his mind and passion, the focus for his compulsive and integrative search for unity, the stimulation for his obsession for learning and growth, and the receptacle for his vast energy and countless ideas. He was to die, "muttering sadly: 'I had in my head enough for forty years more ...'" (Huyghe, 1963, pg. 29)

WILLIAM MORRIS: 1834-1896

William Morris is best known art historically for his work as a designer and his leadership role in the revival of the Arts and Crafts Movement in late nineteenth century Britain. He is, in addition, perhaps equally noted in the history of aesthetics for his Socialist position politically which stemmed from and influenced his own aesthetic philosophy. There are some, as well, whose interest in the revived romanticism of the Middle Ages, which flourished in some groups in Britain during the mid-nineteenth century, who would have known Morris as a poet, and in fact, his collected works in writing are surprisingly numerous and take up twenty four volumes. In point of fact, Morris was a surprisingly versatile artist, and by the end of his life, was not only a master designer, and craftsman, being proficient in painting, carving, weaving, dyeing, printing, embroidery, and illumination, but was also a decorator, a lecturer on Art and Socialism, a publisher, a poet, and a translator of Icelandic Sagas. Asa Briggs (1962) has described him as "one of the most searching critics of British society in the nineteenth century," (pg. 13) and Bernard Shaw (1936) describes him as "a very great literary artist" and the "One acknowledged Great man" of the early Socialist Movement (pg. 22). Morris described himself in one of the more famous lines of his poetry as "a dreamer of dreams, born out of my due time," and yet he considered himself a practical man, a man of action, and certainly his prolific output in both visual and literary realms stands as evidence of his tremendous energy for work. He was, in fact, a man totally committed to, involved in and dominated by his work, and it is through his actions and his writings, in all of the diverse fields which captured his interest, that one may glimpse the nature of the man, William Morris. Such a glimpse provides the observer with the sensation of incredible versatility, diversity and the often confusing complexity of the man, but a deeper look provides the overwhelming impression of a singularly unified individual, whole, related, but complex.

> His energy impressed all his contemporaries: so did his knowledge. He busied himself with many things, and he was a worker by hand as well as by brain. He could be brusque and he could be boisterous; his talk of fellowship masked his loneliness; he could be aloof and melancholy or jovial and high-spirited. In other words, although he was all of one piece, the piece was complex.
>
> (Briggs, 1962, pg. 19)

The most fitting and likely point of departure in examining this complex, "all of one piece" individual, is the concept of reality, or world view which manifested itself throughout his life and works. Almost all of Morris's activities, in art, in literature and even in the political realm, can be seen to have stemmed from or relate to his deep and abiding love of natural beauty. All of his activities in the manual arts, as a manufacturer, designer, decorator and craftsman, though seemingly the dabblings of a prodigious dilettante, were natural outgrowth of his consuming concern for reviving the beauty of architecture, which was for Morris, in its widest sense, the "beginning and end of all the arts of life." (Mackail, 1950, pg. 67) To Morris, every individual had a right and need to have beauty in his environment, and thus architecture, the "mistress-art," and the decorative arts that supported "her" should more than anything else provide men with the beauty they deserved and rise them up out of the artistic degradation Victorian "progress" had brought about.

> To him the House Beautiful represented the visible form of life itself. Not only as a craftsman and manufacturer, a worker in dye stuffs and textiles and glass, a pattern designer and decorator, but throughout the whole range of life, he was from first to last the architect, the master craftsman, whose range of work was so phenomenal and his sudden transitions from one to another form of productive energy so swift and perplexing because, himself secure in the centre, he struck outwards to any point on the circumference with equal directness, with equal precision, unperplexed by artificial subdivisions and untrammelled by any limiting rules of professional custom.
> (Mackail, 1950, pg. 81)

3

His primary and continual interest in architecture led him quite naturally into much of his research and consequent involvement with the decorative arts. Contemptuous of the lack of "art" and quality which had become accepted in his time, and with a deep knowledge and love of the Middle Ages and the quality of Gothic, he naturally set himself to producing what he could not find, not only for Red House, his own first house, but for others as well. Thus began one of the most creative and prolific careers in the history of design, for aside from running the business of Morris and Co. formed in 1861, Morris produced fifty different patterns for wallpapers, worked out in two hundred and thirty-seven different colours; for chintzes, forty-two designs in a hundred and fifty-nine colour variations; thirty-two designs for woven fabric, set in a hundred and sixty-four colourings, as well as the designs for hand-made carpets, the Arras tapestries, silk damasks, embroideries and the designs for the initials, borders, and ornaments for all the Kelmscott books. (Kelmscott Press was Morris's printing and publishing company, started in 1891.)

His work as a designer shows a deep love of natural forms, of clarity, of harmony, and of functional simplicity. His designs for decorative papers, chintzes and fabrics displays an "ordered intricacy ... a free and yet precisely adjusted pattern," (Mackail, 1950, pg. 290) and one sees the artist's love for and deep knowledge of Nature exhibited over and over again in these works. His works in glass, in furniture and in decorating echo his return to simplicity, function and clarity and in combination with his total design output, stand as a strong break from the fussy and over-ornamental eclecticism of the Victorian age. "In this he anticipated the whole direction of the modern movement in architecture and design." (Henderson, 1950, pg. 36)

It is difficult to determine whether Morris's knowledge and fascination with the 13th century was causally connected with his dissatisfaction with the Victorian age, or whether both were outgrowths of his intense passion for natural beauty and for art, (of which he saw much in the 13th century and little in his own to please him). His concern for the preservation of old buildings, for medieval romantic verse, and for the individual's involvement in the creation of beautiful works of art, as typified the guilds and artisans of the Middle Ages, stands as a strong example not only of his sympathy with the 13th century, but also of his natural tendency to relate and connect all aspects of his life to central concerns. He integrated his sympathy for the Middle Ages into his massive production of Romantic poetry, into his theories of art, into his own production of art and craft objects, into his public life, his business and indeed even into his Socialist politics.

Morris and Co., his firm for design and manufacturing, was run almost single-handedly by Morris himself and was responsible for reviving many of the dying or already dead manual arts of the Middle Ages. Through Morris, tapestry weaving, the arts of dyeing and even embroidery and stained glass work were revived to their traditional forms, hand-production, and to the level of quality which mechanization had stripped them of in Victorian England. For Morris, theory and practice were integrated. No work was carried on in his shops that he could not do himself, and he spent much of his time experimenting and doing research into the arts of weaving, dyeing, carving, and illumination. To him there was no essential difference, nor should there be a division, between the artist and the workman. His own experience had led him to the position in which he never designed anything he did not know how to produce with his own hands, and he was committed to, and urged in his lectures on art, the integration of the two functions, design and production, or at least, a reconciliation of the divorce between them that held between the artist and the manufacturer.

What was of primary importance to Morris however, in all realms, but especially in art, was that work should be a pleasure for those who did it. This attitude towards work had a dual manifestation, and could be detected both in Morris's own methods of creation, that is in his own work whether in crafts, design or poetry, as well as in his views on Socialism and his theories on art. Again, Morris appears in this respect, "all of one piece," and applied or related his personal predilections outwards to all that was external to him.

His own work was a pleasure to him, and indeed he loved it deeply and considered and approached it with the joy and intensity which most men attach to recreation. It was his total absorption and the pleasure he found in it was his weapon against boredom and routine, both of which he abhorred. He loved Chaucer and the thirteenth century, and where most men with such a love would treat it as a hobby, Morris wrote romantic verse with a fervour and productive output that would have staggered many full-time poets. He took his pleasures to him and made them his work. His hands were rarely idle and such pleasures as he found in the manual arts, he made them also his into his work. He was fascinated by it as well as committed to it and had learned "in a way that few can, the great secret of not doing, whether under the guise of work or amusement ... what he did not want to do." (Mackail, 1950, pg. 225) He often said himself that "no work which cannot be done with pleasure in doing, is worth doing," and consistently, even in his later Socialist days where "cause" became important to him, pleasure remained the deep and forceful motivation in Morris's works.

There is no doubt that Morris was possessed of a rich and active imagination, as in addition to his "dreamer of dreams" description of himself, he exhibits a continual use of fantasy in all of his prose and verse creations, which add a complementary aspect to his "functional" leanings as a designer. One must not imagine however, that his "Romantic" and fantasy oriented poetry was in any way typical of the great emotional, romantic movement in the 19th century. Morris was indeed a dreamer, both artistically, philosophically and socially, but his works exhibit no vagueness, no emotional outbursts or imbalances, and none of the excesses that are thought to typify Romantic art in its formal sense. In point of fact, his designs and poetic works exhibit highly ordered and intricate structures, complexly interlaced so as to create a unified whole, and there is little about their structure or organization which implies the "passionate" or mindless emotional spontaneaity usually attached (mistakenly, I might add) to Romanticism.

His absorption and intense concentration on work, and his ability to focus on his own doings might well suggest that Morris was, for the most part, unaware or uninvolved in the rest of the world which moved about him. Quite the opposite was true, and in fact, little happened which his keen observation did not record, and which his active mind did not digest. One might easily assume that Morris, having placed his love in the thirteenth century as his ideal, remained unaware and oblivious to his own time and place. Bernard Shaw recalls that Morris disliked, or appeared to dislike talking about anything in art more recent than the Pre-Raphealites, and, thus appeared to have no patience or understanding for modern art. In fact, wrote Shaw, he appeared "a petulant veteran willfully and invincibly ignorant of the latest developments." (1936, pg. 24) Shaw was mistaken however, and found as much later when he had proved himself knowledgeable enough on the arts for Morris to talk to. He found that the subject had been avoided, as with so many others, because "it was a fixed and very sound rule of his that it was no use arguing with a man who didn't know." (Shaw, 1936, pg. 24) Once Morris had determined Shaw's sensitivity, he soon disillusioned him as to his apparent ignorance of modern art, and proved himself as knowledgeable on Whistler as he was on Van Eyck.

In relationship to Nature, Morris was not only deeply attached to it, but also appears in his letters and other writings, as a keen and sharp observer of it, fascinated by it's changes and in love with its beauty. He had a great knowledge of Nature as well, often visited the Zoological Gardens and was especially knowledgeagle about birds and their habits. While a young man he kept an owl in his rooms in Red Lion Square and could even "imitate an eagle with considerable skill and humour, climbing on to a chair, and after a sullen pause, coming down with a soft heavy flop." (Mackail, 1950, pg. 119)

Mackail, whose "Life" still stands as the standard biographical work on Morris, describes his love for Nature as follows:

> Above all, beyond even his delight in great buildings, in history, in the masterpieces of human invention, lay in him that intense passion for Nature.
>
> (1950, pg. 227)

Morris acquired Kelmscott House in 1871, and it is in his letters from this haven in the country, that he exhibits his observations and keen interest in his natural environment. One excerpt from a letter to Mrs. Burne-Jones, chosen from many available on such observations, should serve as an example:

> The other morning as I was coming up the river by our island, I heard a great squealing of the swallows, and looking up saw a hawk hanging in the wind overhead, and the swallows gathered in a knot near him: Presently, two or three swallows left their knot and began skirting Mr. Hawk, and one swept right down on him and fetched him a crack (or seemed to). He considered for a minute or two, then set his wings slantwise and went down the wind like lightning, and in an instant was hanging over Eaton Hastings: I remember seeing something like this in the flats about the Arun before ...
>
> (Henderson, 1950, pg. 152)

His letters from Kelmscott are filled with such observations and the only other source where such detailed description of Nature abounds is the Journals Morris kept on his travels in Iceland in 1871 and 1873. These Journals fill two hundred and thirty-five pages and coupled with his letters to friends and family at home, comprise a detailed account of the sights, sounds, smells and thoughts which occupied his acute senses during the journey.

His keen observational powers were accompanied by an amazing and prodigious memory. Fifty years after seeing the church of Minster in Thanet, which he had entered once as a boy, he described it to a friend as if he had been in it the day before and had taken notes of its characteristics in the greatest detail. It was no doubt this quick, precise and retentive eye and mind, coupled with his love and fascination for the earth and her beauty, which enabled Morris to nourish his tremendous output as an artist.

Socially and personally, Morris remained dominated by his work. Though he was loyal and often boisterous with his small circle of friends, he was, throughout his life, consistently unconventional, contemptuous of social pressures and expectations, quite unconcerned about public opinion and entirely self-sufficient. He disliked the superficiality of Victorian society and had "little interest in tittle-tattle, or in other people's affairs, or in society with a capital S, and he did not go out of his way to make other people's acquaintance." (Cockerell, 1950, pg. X) He found the trivialities of social gatherings boring and narrow and regarded them as somewhat of a torture, he often made excuses so as not to have to attend them.

> Though Morris was rich in the enormous patience
> of the greatest artists, he went unprovided with
> the small change of that virtue which enables
> cooler men to suffer fools gladly.
> (Shaw, 1936, pg. 51)

His personal life seems to have been pleasant, unobtrusive and harmonious, and there exists no evidence of either great passion or emotional upheaval of any kind regarding it, aside from his anxieties over the health of his daughter in 1882). He made no attempts to interfere with his children, wife or friends and seems to have remained in the position of affable uninvolvement, where most personal issues were concerned. Shaw writes of Morris's attitude towards his children,

> As to any kind of coercive interference on his part, it was inconceivable. He knew that the world was full of precipices; but if people were determined to walk over them it was no use trying to hold them back; over they must go.
>
> (1936, pg. 40)

It rarely entered his head to consider other people, absorbed as he was in the work and world he was creating for himself, and in dress and habits, was simple and untidy, often looked quite bizarre, with blue dye on his hands and unruly hair. He was totally unaffected and most of the time, simply ignored the claims of Victorian society. His journeys to Iceland, his boating trips up to Kelmscott (accompanied by boisterous and often prankish exuberance), his appearance, and his lack of concern for criticism, all speak of his unconventional deviation from the norms of the cultured sophistication, the strict social rules and the concern for appearances which were prevalent in Victorian England.

Morris did establish some close friendships in his lifetime, most notably with the painter Burne-Jones and his wife. Though he was loyal and affectionate in such relationships, there lacks an intimacy, a personal commitment on a deeper level, and any evidence of strong emotion is missing from his letters and the reports of friends and colleagues. He arranged his life in reference to things rather than people, and Mackail sums up his personal life as follows:

> Morris had always been one of the people to whom personal matters bear far less than their normal share in life. He had always been more interested in things than people. He had the capacity for loyal friendship and for deep affections; but even of these one might say that they did not penetrate into the central part of him.
> (1950, pg. 99)

It might then seem odd that Morris became, later in his life, so actively involved in the foundation of the Socialist movement in Britain. Indeed, it is not so surprising as it would seem, for his involvement was accompanied less by personal emotion, or concern for individuals, than it was an ideological and intellectual reaction and quite a logical one; relating itself first and last to his beliefs on art. Morris held a philosophy of art which was based on the firm belief that all men must have beauty in their lives and should desire it enough to produce it. He "wrought a silent revolution in those arts which he practised and transfigured, and the whole of whose extraordinary powers were devoted towards no less an object than the reconstitution of the civilized life of mankind." (Mackail, 1950, pg. 3) For Morris, in attempting to redeem the manual arts from the ugliness and commercialism of his time, to restore to them the beauty and more functional basis of his beloved 13th century, it was natural that he would inevitably come to question the social life which had brought them to their decline. He desperately wanted social changes which would allow the renewal of art and beauty and saw political change necessary for, or as the same thing as the social one. His involvement with Socialism was an almost inevitable extension of his art theories, and as a socialist, he remained centrally an artist. His approach was through aesthetics. He felt that the arts would become extinct in an industrialized society and thus rebelled against the industrialization, the mechanization, the impersonality and the inevitable separation of the artist from the created object which followed from it. He saw, however, that a regeneration of the arts, the return to the artist as craftsman must be approached not only through aesthetics but from a broader and more basic change in the structure of society.

Morris wrote and lectured a great deal on Socialism, was very active for a number of years and there is, necessarily a great deal that could be examined in regard to his social and aesthetic theories. It is a complex issue, however and cannot be fully treated here so it must suffice to give only a few examples of his position politically and his political dealings with others. Though there exists no single statement which summarizes Morris's socialist philosophy, the following excerpts from his essay, "How I Became A Socialist" may provide a glimpse at least of his rationale.

> Apart from the desire to produce beautiful things, the leading passion of my life has been and is the hatred of modern civilization ...
> ... The hope of the past times was gone, the struggles of man kind for many ages had produced nothing but this sordid, aimless, ugly confusion; the immediate future seemed to me likely to intensify all the present evils by sweeping away the last survivals of the days before the dull squalor of civilization had settled down on the world ...
>
> ... Well, what I mean by Socialism is a condition of society in which there should be neither rich

> nor poor, neither master nor master's man, neither idle or overworked, neither brain-sick brain workers, nor heart-sick hand workers, in a word, in which all men would be living in equality of condition, and would manage their affairs unwastefully, and with the full consciousness that harm to one would mean harm to all ... the realization at last of the meaning of the word COMMONWEALTH ...
>
> ... Surely anyone who professes to think that the question of art and cultivation must go before that of knife and fork (and there are some who do propose that) does not understand what art means, or how that its root must have a soil of thriving unanxious life ...
>
> ... It is the province of art to set the true ideal of a full and reasonable life before him, a life to which the perception and creation of beauty, the enjoyment of real pleasure that is, shall be felt to be as necessary to man as his daily bread and that no man, and no set of men, can be deprived of this except by mere opposition, which should be resisted to the utmost.
>
> (Briggs, 1962, pg. 33-37)

Morris's theories on Socialism were, as were those on art, integrated with practice and his shops at Merton Abbey were operated in full accordance to them. Though in 1890-91, his active role in the Socialist League was abandoned; it was through disillusion with methods rather than theory, and he held to his views throughout his life. He had no religious views, long having rejected church dogmas, and thus, his aesthetic and socialist views were perhaps the only ones which he held till his death in 1896. He had lived only to the age of sixty-two, one doctor diagnosed his disease as "simply being William Morris and having done more work than most ten men." (Henderson, 1950, pg. 40). But even if he died at a comparatively young age, William Morris, in life had been one who "felt the world perpetual in its interest and its variety, and to whom no length of days could be long enough to exhaust either the work that there was for him to do or his own active pleasure in doing it." (Mackail, 1950, pg. 338)

PABLO RUIZ PICASSO: 1881-1973

In the history of art, Pablo Picasso holds a similar, if not parallel position to that of Einstein in the history of science. Both men, through their creative contributions in their respective fields, radically changed the conventions and traditions of the early twentieth century and altered our held conceptions about the nature of art and science. They are alike too, in the fame and even notoriety each gained in their lifetimes, even though few would presume to understand the full meaning or implications of their work. Even in a society basically uninformed and undereducated in the realm of art history and aesthetics, Picasso's name is familiar to most and upon his death in 1973, the London "Times" described him as:

> The most famous, the most controversial, in many ways the most influential, and undoubtedly the richest artist of his age. He was a draughtsman of genius and there is probably no single artist except Giotto or Michelangelo who can justly compare with him in being responsible for so radically altering the course of art in his time.
> (O'Brian, 1976, pg. 185)

Picasso is, of course, most widely known for his foundation of Cubism, and aside from considerable misunderstanding of his intentions in regard to his Cubist painting, there is as well, outside the realm of the visual arts, little awareness of his work in sculpture, lithography, engraving and pottery. The fact that Picasso at no time in his life was a willing writer of letters, of journals or of his artistic views, leaves the interested observer with his vast body of visual work, the few verbal statements he did leave on record, as well as the reports of those who were close to him, as the major sources from which to gain insight into the man himself. It is from these sources, that one quickly moves beyond the general superficiality of the label which has coupled Picasso with Cubism and has, for many, provided the sole terms for understanding and describing the artist and the man.

It is difficult to find verbal sources for Picasso's views on the world, on art and on life. His recorded statements in all areas are often contradictory, and it would seem that he disliked intensely any attempts at philosophical or theoretical explanation of his work. His work itself, however, in its apparent diversity, eclectism and complexity, illuminates the artist and the man as strongly rooted in the physical, natural world of things. Picasso, for all his distortions and abstractions, never deserted the object, and his consistent use of it as starting point and link between painting and Nature, is an indication of a world view which avoided metaphysical foundations and built rather on present, concrete reality. For Picasso, "Painting is the equivalent to nature," (Ashton, 1972, pg. 18) and his continual integration of natural forms into his paintings speaks of his acceptance, fascination and commitment to the natural world.

He loved the sun, the sea, and the country, and had an immense awareness of natural beauty. His work demonstrates a vision of reality in which all and any aspects of Nature become suitable subject matter or materials for art. He invested great value in objects, saw beauty where many saw only discarded objects, and was entranced and stimulated by the forms he saw and gathered around him in his environment. His ability to see beauty in common place and daily objects, his compulsion to collect them, his predilection for integrating them into his work, were consistent and dominant factors throughout his life. It was as if the entire natural world was for Picasso, a palette, a complex and beautiful collection of objects and colors which he could transform into more beautiful objects. He saw art and Nature as parallel, as interactive forces which created beauty, and was content to love them without trying to explain them philosophically. He expressed his views on this matter in the following statement:

> Everyone wants to understand art. Why not try to understand the song of a bird? Why does one love the night, flowers, everything around one, without trying to understand them?
> (O'Brian, 1976, pg. 142)

The central unifying force in his life was his painting, and in it, or through it, he brought to bear the forces of personal, emotional, intellectual and even his political life. That which he took in through his senses and his mind, inevitably reappeared, transformed, synthesized, integrated into his one dominating and driving compulsion to express. His painting, his printmaking, his sculpture, his pottery, his book illustration, and his works for theatre, remained for Picasso, means for a totally personal expression. In fact he says himself of this highly personal element in his work, "My paintings are pages of a diary which I didn't have time to edit." (Schiff, 1976, pg. 5)

There still exists a great deal of disagreement as to the implications of Picasso's work, both for an understanding of the intentions of the artist, as well as for an understanding of the man himself. Certainly this is no place to plunge into aesthetic or theoretical analysis of his vast number of works, and so it will suffice to say here, that they consistently were a personal, rather than an intellectual or merely aesthetic expression. Clive Bell (1976) claims that Picasso was a literary painter, "He always was: again and again his pictures express an emotion that did not come to him through the eyes alone." (pg. 86) There is little doubt that his life outside the studio, had a great influence on what was created within it, and certainly his relationships with women had a consistent and strong effect on his work.

It is then, to his methods of work, his approach to the creative process, and to his personal life, that one might turn to find the clearest picture of Picasso.

Picasso was dominated by his art. For him the process was all important and he hated finishing works, considering them dead once finished. His creative process depended on a continuous interaction between the painting and himself, and was intuitive, synergic, and synthetic rather than intellectually established in advance. He described the process as follows:

> ... A picture is not thought out and settled beforehand. While it is being done it changes as one's thoughts change. And when it is finished it still goes on changing, according to the state of mind of whoever is looking at

> it. A picture lives a life like a living creature, undergoing the changes imposed on us by our life from day to day.
> (Ashton, 1972, pg. 8)

He said as well;

> I consider a work of art as the product of a series of calculations, calculations that are frequently unknown to the author himself. It is exactly like the carrier pigeon, calculating his return to the loft. The calculation that precedes intelligence.
> (Ashton, 1972, pg. 30)

At different times in his life, Picasso both denied and affirmed the idea that his work was "research." Although, due to his own contradictory statements on this aspect of his work, one cannot generalize on this tendency, there is a strong and definite trend in his methods of exploring form which might at least be called experimental. Certainly, in all of his statements on art, Picasso shows himself as more concerned with process than product, with painting than with paintings, and essentially with the continuing active "search" for adequate expression. His comments on his own work and intentions contain the following remarks which indicate his emphasis on exploration and process. His aim, he said, was:

> ... to paint seeking new expression divested of useless realism, with a method linked only to my thought ...
> (O'Brian, 1976, pg. 166)

He saw painting as work with no conclusion, no finite end; a painter was never satisfied. In this regard, he made the following statements:

> But the worst thing of all is that he has never finished ... as soon as you stop you have to start again. You can put aside a canvas and say you won't touch it any more. But you can never write the words THE END.
> (Parmelin, 1969, pg. 17)

> A painter's atelier should be a laboratory. One doesn't do a monkey's job here: one invents.
> (Ashton, 1972, pg. 51)

> If you know exactly what you are going to do what's the good of doing it? There is no interest in something you know already. It's much better to do something else.
> (Parmelin, 1969, pg. 33)

Finally, in this regard, Picasso's most quoted statement concerning his process should be mentioned. "I do not seek: I find," he said, and as it stands it seems to imply a lack of exploration. It must be viewed, however in reference to its opposite; "One never stops searching because one never finds," (Parmelin, 1959, pg. 38) and in fact, his work shows quite clearly that in reality "he finds constantly and seeks constantly." (Parmelin, 1959, pg. 38)

Aside from his process-orientation, his synthetic abilities, and his intuitive or instinctive emphasis, Picasso's work displays a violent break with tradition and convention. This factor is not surprising, for he was consistently rebellious and unconventional in all aspects of his life. He never in his life allied himself with groups of any kind, rebelled against traditional art forms and remained aloof from the modern ones. After the Cubist revolution, he continued to rebel and to revolutionize his own painting throughout his life. He was totally non-static, and maintained his remarkable ability to break out in new directions, irregardless of criticism, till the end of his life.

Picasso's social behaviour stands also as an example of his rebellion against social tradition, and convention. He was highly unconventional, painting furniture on the walls of his apartment when too poor to buy any, shooting off revolvers late at night in the Paris streets, keeping odd animals which varied from an ape in the apartment to a white mouse in a drawer. The stories surrounding this aspect of his personality are infinite, and though many are exaggerated and some fabricated, there is little doubt that Picasso did not modify his behaviour any more than his painting to mollify social norms. In fact, it is clear that his great energy and joyous often earthy sense of fun, was sometimes deliberately focussed towards shocking others and provoking reactions through his unconventional behaviour. He carried his unconventionality as well as his sense of spontaneous fun to his grave, and even at the age of 77 could be seen dancing in a ladies' nightdress on the balcony of "La Californie" or greeting friends while in the bathtub.

Picasso has been described as having "the creative genius of a child" (O'Brian, 1976, pg. 342), and his enchantment with the visual world of objects is described as that which is "common among the very young." (O'Brian, 1976, pg. 169) Burgess (1976) writes of his painting that "his canvasses fairly reek with the insolence of youth," (pg. 30) and in most biographical accounts of his life, one continually finds this aspect of his personality emphasized. His incredible youthfullness, even in the last years of his life, can best be illustrated through his spontaineity, his play behaviour, and through his steadily maintained curiosity and exuberance for life. In his seventies, he would create masks to please and frighten small children, he would dress up, a matador one moment, a clown the next, he would coax his wife to teach him ballet steps and prance about the studio as a dancer, and would shoot revolvers at tin cans with Hollywood movie stars who came to visit. In the middle of a meal, he would pick clean the bones of his fish, jump up and press the pattern of the skeleton into the wet clay of his pottery, and he maintained his great exuberance for social gatherings of his friends. It is, no doubt, in these aspects of his character, that his youthfullness is most clearly exhibited.

Picasso loved social gatherings of his friends and maintained a fairly active and boisterous social life until near the end of his life. He worked in total and complete solitude however, and the prodigious amount of work he created indicates that his social activities were not distracting. His more intimate personal relationships with women, of whom there were a fair number, had tremendous influence on his work, primarily in terms of content rather than production. His emotional harmony or upheaval was a fairly consistent element in his painting, and serves to reinforce the fact of his deep emotional involvement in painting and his integration of his studio and non-studio life. The Blue Period and it's deep sadness and despair, gave way to the warmth and blooming fullness of the Rose Period, at the time when Picasso began his long relationship with Fernande Olivier. The distorted and monstrous females appeared in his paintings at the same time when his marriage to Olga was disintegrating and again when his affair with Dora Marr was in its final stages. The voluminous classical nudes and maternities appeared in paintings following the birth of his first child Paulo. His painting then, was integrally related to and interactive with his personal emotional circumstances, and again it becomes clear that Picasso lived his painting and painted his life. He did not compartmentalize or fragment his life, but rather remained open in his work to all that flowed through his life. It is interesting to note here, that though Picasso was deeply attached to all of his women, and apparently remained so, he left each one behind except Jaqueline Hutin, who was with him at his death. He could not bring himself, however to part with the phenomenal number of objects he had acquired, his studios, and various houses being full of everything from scrap postcards to African masks, and each time he moved, he would have nothing thrown away.

Picasso exhibits both an awareness of and an involvement in social issues of his time. Both his awareness and involvement however, are on a fairly naive and idealistic level and aside from "Guernica" and a few other works, his art exhibits as little involvement as Picasso himself. "Guernica" was, without doubt, a violent social protest against the German bombing of that town in 1937. It is a highly emotional cry of outrage and horror at the brutality of the action, and in it, Picasso makes clear his humanism, his passionate emotional involvement with Spain and with his art, in addition to making explicit his deep hatred for Facism. He remained, however, uninvolved in both world wars, rebelling against Nazi pressure by remaining in Paris and painting throughout the Occupation. After the war, he declared himself a Communist, in a fit of enthusiasm following the liberation of Paris. He explained his action in an interview for the "New Masses," a New York paper.

> My joining the Communist Party is the logical outcome of my whole life and of the whole body of my work. For I am proud to say that I have never looked upon painting as an art intended for mere pleasure or amusement: since line and colour are my weapons, I have used them in my attempt at gaining a continually greater understanding of the world and of mankind, so that this understanding might give us all a continually greater freedom. In my own way I have tried to recount what seems to me the truest, the most exact, the best; and naturally, as the greatest artists know very well, that is invariably the most beautiful too.
>
> Yes, I do feel that by my painting I always fought as a true revolutionary. But now I have come to see that even that is not enough: these years of terrible oppression have showed me that I have not to fight only with my art, but with my whole being.
>
> (O'Brian, 1976, pg. 373)

Picasso explained later to a friend, "You see, I am not French but Spanish, I am against Franco. The only way I could make it known was by joining the Communist Party, thus proving that I belonged to the other side." (O'Brian, 1976, pg. 375). He never read Marx, nor it would appear, anything else concerning Communism, but joined as a reaction against what he had seen in Spain in the war, rather than in response to a deep positive understanding and commitment to Communist theory. It was then, more an act of his idealistic humanism and basic revolutionary character, than of a serious communistic beliefs. In point of fact, his art speaks more clearly in this matter than any other component, and it was and remained totally contradictory to the Communist philosophy of art for the people.

Picasso became a considerable embarassment to the Communist Party for the very reason that his art did not conform in the least to the social realism demanded by Marxist dogma. In any event, Picasso was neither highly active nor highly verbal within the Party, and his political involvement can be seen as minimal and intellectual, if not somewhat naive.

Picasso remained, through all his personal and public involvements, primarily and essentially an artist. His profound influence on modern art did not stop at painting, but permeated theatre design, book illustration, lithography, pottery and sculpture as well. In his work can be found the source of Cubism, and the roots of modern movements such as Surrealism, Dadaism and Futurism. "He demonstrates that Mankind and the world are daily invented by Man himself." (Einstein, 1976, pg. 80)

PAUL CEZANNE: 1839-1906

Paul Cezanne was a painter. He is considered by many art historians as a Post-Impressionist, by some as an Impressionist, and others treat him as a member of no group at all. The one factor on which most art historians seem to agree, however, is that Cezanne was responsible for a revolutionary alteration of pictorial space in Western painting, which laid the foundations for the modern art of the twentieth century. Canaday (1969) writes the following passage which aptly places Cezanne in the context of late 19th century painting:

> Paul Cezanne was the same age within a year or two as Monet and Renoir. He was younger by nine years than impressionism's patriarchal figure, Pissarro ...
>
> ... He was separated by some six centuries from Giotto, who had initiated the revolutionary concepts of space and reality that, perfected in the Renaissance, had remained the foundation of Western painting in spite of all variations and refinements until Cezanne initiated the revolution called modern art.
>
> (Canaday, pg. 1111)

Cezanne was, to the younger generation of modern painters, seen as a leader, as the strong rebel against tradition. He was a primary influence on Picasso, who said of him, "He was my one and only master ... I've spent years studying his pictures ... Cezanne -- He was, as you might say a father to us all. It was he who protected us." (O'Brian, 1976, pg. 156). Picasso also said, "From the point of view of reality, what Cezanne was doing was far more advanced than the steam-engine," (Parmelin, 1959, pg. 112) and there is no doubt that Cezanne's painting, though ridiculed and misunderstood throughout most of his life, was revolutionary both in itself and in its impact upon the following generations of painters. He became "the most powerful single source of inspiration for the break from tradition called modern art" (Canaday, 1969, pg. 1124), and as this source, his place in history is assured.

Two dominant forces appear as the primary aspects of Cezanne's world view or approach to reality; the love of Nature, and the search for a unifying structure within it. Having spent his youth and the greater part of his life in the Provencal countryside around Aix, Cezanne developed a love of the natural world which sustained him throughout his life and became the primary focus of his art. He spent a great deal of time outdoors, walking and painting and observing in the countryside and never felt entirely at home in the urban environment of Paris, where he lived for short periods on and off throughout his adult life. Cezanne's love of Nature was intrinsically tied to the search and struggle in his work to find a controlled and disciplined method which would express his "sensations" of Nature, and which would uncover the unified structure he saw within it. He sought for a strong system, which would synthesize the details and the whole, would fuse the elements of Nature into a clear, ordered and structural unity. By 1877, he had learned what he could from Impressionism, from Delacroix, Pissarro and Manet, and had arrived at his unified personal rendering of space. He integrated the freedom of colour he had gained from Impressionist experiments into his own quest for greater solidity of form and structure.

> He took over its essentially harmonious or idyllic world, but carried on from his earlier phases the need to solidify the earth, which Impressionism in its logical extremes threatened to dissolve in a sweep of reflected lights or reduce to a schematic system of colour divisions.
>
> ... The harmony that he required in his innermost being was not a lyrical cry of praise to certain aspects of landscape; it was a harmony that emerged from as full a grasp of all the elements as possible, one that included permanence as well as the impermanence, stable structure as well as the ocillations, asymmetries and tensions of change.
> (Lindsay, 1969, pg. 158)

Even Cezanne's method of working all over the canvas at once, a system he adopted in his mature style, provides a key example of his unifying and integrative vision. Each stroke altered the tensions of colour and form and created new relationships within the whole. Cezanne was not so much painting pictures of Nature, but recording sensations of the inner attractions and repulsions of natural structures; he was "treating his motif as a living system." (Lindsay, 1969, pg. 198) His was an intuitional grasp of Nature, or reality, in its "immediate fullness" with full consciousness of the relationships and changing interactions between elements of form and colour. (Lindsay, 1969, pg. 199) He was more concerned with these relationships, with the interactive, integrative tensions between objects, than he was with the objects themselves, and with the ultimate harmony of those relationships. He wrote to his friend Gasquet in 1897, "Art is a harmony parallel with nature." (Lindsay, 1969, pg. 281)

In his later years, Cezanne became a leader, though through no wish of his own, for the young avant-garde painters in Paris. It is in his advice, and counsel to these younger painters, especially Bernard and Camoin, that he articulates his views on art and Nature, more clearly than anywhere else. In these letters, aside from his continual stress on Nature as the painter's only source, Cezanne consistently refers to his own work as "study," "research," and "search." He refers to paintings as "instruction" and emerges consistently as a growth-oriented and process-based painter. To underestimate this aspect of Cezanne's character, his world view, his work, would be to miss the driving force behind his entire life as an artist.

> I must strive after perfection only for the pleasure of giving added truth and learning.
> (1874, letter to his mother, in Rewald, 1941, pg. 99)

> To achieve progress nature alone counts, and the eye is trained through contact with her.
> (to Bernard, 1904, in Rewald, 1941, pg. 239)

> The painter must dedicate himself wholly to the study of Nature and try to produce pictures which are an instruction.
> (to Bernard, 1904, in Rewald, 1941, pg. 236)

> The real and immense study that must be taken up is the manifold picture of nature.
> (to Bernard, 1904, in Rewald, 1941, pg. 236)

> ... I am going ~~on~~ with my research and shall inform you of the results achieved, as soon as I have obtained some satisfaction from my studies.
> (to Vollard, 1902, in Rewald, 1941, pg. 224)

Statements such as these, abound in Cezanne's letters to younger painters, and perhaps might be summed up by his own definition of the true path of painting as "the concrete study of nature." (to Bernard, 1904, in Rewald, 1941, pg. 236)

Cezanne was highly emotional and invested almost his entire emotional output into his work. His creative process demanded intense concentration and he was often frustrated by his lack of "results," so much so, at times, that he would throw his brushes at the ceiling or give way to emotional outbursts. His radical break with traditional painting, and his often abrasive personality, left him with little support or understanding of his work until later in his life. He withdrew from people, often violently, to work in solitude, often living like a hermit, seeing no one, letting none enter his studio. There exists a rather legendary image of the rough, unconventional foul-mouthed painter from Aix; one that paints Cezanne as violent in temper and behaviour, totally anti-social and the archetype of the temperamental, perhaps mad artist. There is no doubt that this is an exaggerated image, based more on Cezanne's refusal to establish close personal relationships and on his discomfort in social settings than on a real knowledge of the artist himself. There is however, as with most legends, a grain of truth at its foundation, for Cezanne was in reality highly obstinate and basically distrustful of people. His long and intimate friendship with Zola was abruptly terminated by Cezanne in 1886 with the publication of Zola's "L'Oeuvre," which to Cezanne represented a betrayal of faith and a lack of understanding on Zola's behalf. In addition, Cezanne had a deep contempt for intellectuals and clever speakers of any kind, often reacting to such conversations with "L'esprit m'emmerde." (Lindsay, 1969, pg. 102) Such forthrightness, coupled with the deep emotional moodiness often provoked by his work, was no doubt enough to alienate him from the social milieu at the time. He had little more respect for social conventions, than he had for artistic ones, and for the most part simply ignored them and throughout his life withdrew steadily from social contact of any kind.

Though he had a long relationship with Hortense Fiquet, who ultimately became his wife, it seemed to have little effect upon him in any way at all, aside perhaps from causing a great deal of anxiety regarding his father's acceptance of the situation. She is treated in his paintings, as in his letters as an object, neither adding nor detracting in any way to his main concerns. They lived apart a great deal of the time and it is clear that Cezanne needed harmony in his personal life more than he could handle distractions. His eternal struggles against the will of his father, who opposed his painting, had left Cezanne with a total need for stability rather than conflict in his life. He would, in fact, rather lie than bring the issues with his father to the surface, and withdrew from all personal relationships which introduced conflict or tension. Cezanne remained close to his mother and sister, however, and it would seem that this was due to their consistent support of his work, as well as the undemanding stability with which they provided him. He drew a certain security from such ties, and perhaps is describing his own feelings when he writes to Charles Camoin in 1902 ...

> ... I congratulate you on being with madame your mother, who in moments of sadness and discouragement will be the surest point of moral support and the most vital source from which you can draw fresh courage to work at your art.
> (Rewald, 1941, pg. 220)

Cezanne's withdrawal from people, both socially and personally, was so intense that he even had a fear of physical contact, becoming enraged if anyone touched him. The Pissarro children and even his housekeeper has specific instructions to avoid touching Cezanne, and his total refusal to become deeply or intimately involved with anyone, seems to be related to this. Both physical and emotional contact were intrusions on him, were penetrations of his privacy and he often spoke resentfully of people "getting their grappin into him." (Lindsay, 1969, pg. 82)

He maintained his demand for solitude and privacy even after his work gained some supporters, and resented any attention given to his personal life. He wished to remain anonymous:

> But I curse the X's and the few rascals who, for the sake of writing an article for 50 francs, drew the attention of the public to me. All my life I have worked to be able to earn my living, but I thought one could do good painting without attracting attention to one's private life. To be sure, an artist wishes to raise his standard intellectually as much as possible, but the man must remain in obscurity.
> (to Gasquet, 1896, in Rewald, 1941, pg. 198)

... and to his son Paul in 1906 he wrote:

> As for me, I must remain alone, the meaness of people is such that I should never be able to get away from it, it is theft, complacency, infatuation, violence, the seizing of your work ...
> (Rewald, 1941, pg. 269)

Yet as much as Cezanne drew his solitude around him, he remained open to change and new ideas till his death. He was very interested in the younger generation of painters, and gave them encouragement and sympathy. Their views, more modern than his own, did not offend or threaten him, and he felt with some of them a rapport he did not share with the compatriots of his own generation. He wrote to the young Gasquet, "Perhaps I was born too early. I was more a painter of your generation than of mine ..." (Rewald, 1941, pg. 203) and to his son Paul, "I think the young painters are much more intelligent than the others, the old ones see in me only a disasterous rival." (Rewald, 1941, pg. 273) One senses that Cezanne, in his distaste and avoidance of conflict and argument, was more easily drawn to the young painters who supported his work and accepted it with understanding and without question. It is perhaps, the dislike of contention, of the imposition of ideas or will, stemming from Cezanne's constant struggle against his father's manipulation, which provides the most understandable cause for his choice of a solitary and private existence.

Cezanne was active in neither a political nor a religious sense. For a time he held radical views politically, but did not act on them and his involvement was intellectual rather than actual. In his letters there is no indication of any deep piety towards God, or anything else except Nature, and though near the end of his life he went to mass, it was more as a comfort against death, than an act of belief. It was in his work that he found what comfort most would find in religion, and at the death of a friend's mother, he wrote,

> ... but I well know the aching void caused by the disappearance of people we love ... I beg you to devote your time and energy to painting as being the surest means of diverting your sadness.
> (Rewald, 1941, pg. 128)

One doubts the sincerity of his late in life church-going when in the year of his death he wrote to his son, "I think that to be a catholic one must be devoid of all sense of justice, but have a good eye for one's interests." (Rewald, 1941, pg. 257)

In regards to the personal, social, religious and political aspects of life, few artists would appear so removed as Cezanne. He was aware of all that was around him, from music, to literature, to the political events of his time, to the finest complexities of Nature, but severed himself from involvement in all but Nature and his work. His work was revolutionary in rejecting the traditional system of spatial representation, but more revolutionary for his treatment of "each painting as a new problem that could be solved only by finding means to satisfy the demands peculiar to it." (Canaday, 1969, pg. 1123)

> Like all great artists, Cezanne found the formal means to express his responses to the world, and like a handful of them, his means were so revolutionary as to shift the course of art.
> (Canaday, 1969, pg. 1123)

OVERVIEW OF COMMONALITIES AMONG THE ARTIST SAMPLE

This section, like the concluding section of the preceding Chapter, provides an overview of the shared characteristics exhibited by the artists described in the previous pages. Again it should be pointed out that the following comparison is in no way an attempt to reduce individuality or to imply sameness among these artists. Rather, it is merely an attempt to point out certain general tendencies and characteristics which they seem to have in common. On a superficial level, the first and most outstanding characteristic shared by Alberti, Delacroix, Morris, Cezanne and Picasso would seem to be the revolutionary nature of their involvement in art. They represent different historical periods, different nationalities and contributions between them which range through painting, sculpture, architecture, the decorative arts and printmaking. Each was very much an individual and each made revolutionary changes in the course and development of his specific field of endeavour. Yet beyond this, there would seem to be further commonalities and deeper similarities which might be viewed as characteristic of the group.

All of the artists in this group display strong similarities in the view they held of the world, or in their consciousness of reality. Each of them placed Nature in the central dominant position of their view, and each regarded it as an harmonious and complexly structured whole. Alberti's work was a consistent attempt to explain it's lawful and ordered structure and his perception of its harmony invested itself in all his works. Delacroix sought also to express the harmony and balanced unity of Nature in his work and Morris sought to renew the arts by returning to the clarity and simplicity of natural forms. Morris's views on socialist aesthetics, demanding beauty in all the arts for all men, indicate as well the holistic and harmonious nature of his conscious reality. Picasso and Cezanne both set about deep investigations of the natural world, in order to express the deeper structures and harmonies they saw within its forms. All men sought unity in their work, as did they seek to clarify and express inherent structures which they perceived in Nature. All of these artists found or extended their consciousness of unity and harmony through a strong tendency to relate, integrate and synthesize ideas and perceptions. They were connective thinkers, able to relate divergent stimuli and to combine apparently different aspects of the world. Alberti's relationship of music and architecture, of mathematics and pictorial spatial depiction, of surveying and sculpture are more pronounced examples of his tendency towards integrative thought. Delacroix's synthesis of classical and romantic influences in painting, his synthesis of influences as diverse as Constable and Velasquez, his connections between science and art, all present him in the light of integrated thought. Morris connected art, aesthetics, politics, history and manufacturing, in a highly related combination which has influenced both theory and practice in the manual arts ever since. Picasso's work in all media is highly synthetic, integrating at times, objects from the real world into the creation of art. Cezanne's work may be viewed as a synthesis of Impressionist colour and the artist's personal perception of structural form in Nature.

The simple fact that all of these men were artists, and created objects which are by their very nature a synthesis of vision and the manipulation of formal elements, is sufficient to reveal their general tendency towards synthesis and integration of thought. What is more important, however, is that the synthetic process of each was so novel, unprecedented and powerful as to have radical effects upon the art of their time.

Little evidence needs to be reviewed here to illuminate the revolutionary nature of these artists. All were basically unreceptive to the traditions and conventions of their time. All seem to have been inquiry-oriented, questioning as they did the previous established "order of things" in the arts, and all seemed minimally, if at all, limited by mental sets which would have hindered their exploration and expression of their world. None were highly religious in the sense of commitment to organized religion, Delacroix, Morris and Picasso having abandoned or rejected the Church completely, and Alberti and Cezanne (at the end of his life), seeming to maintain only token or superficial involvement. A case might be made for a nature-oriented religious leaning for all five men, but there is too little evidence on which to generalize in this area. Suffice it to say, that none were deeply committed to organized religion, yet all seem to display a "religious" attitude toward Nature and their work.

Imagination, both highly active and esteemed by each, is another obvious commonality between the members of the artists sample. There is, however, almost no verbal record at all, regarding any of these men, which can throw any light on their actual imaginative process. In fact, there is little written by any of them regarding their creative methods, either in thought or in the actual construction of a work of art. One area, however, where generalization might justifiably be made, on the basis of written evidence in all cases but Picasso's, is the consistent application of structure and order to the imaginative and emotional aspects of the creative process. Delacroix constantly refers to order and structure, and applied intellectual discipline to his "temperament," Alberti used mathematical reason consistently in relation to his imaginative work, and Cezanne often spoke of "logic" and sought for a formal and structured system of which would give order to his emotional expression. Morris's artistic creation as a designer was highly ordered, symmetrical and "mathematical" in form, and he too, utilized more formal intellectual thought to supplement his imaginative sources. Although Picasso refused consistently to explain or theorize on his own creative process or products, there can be no doubt that both Synthetic and Analytical Cubism were partly a result of applying a highly intellectual and formal structure of thought to his imaginative expression. Thus, all of these artists, to some degree at least, utilized both formal and intellectual modes of thought in congruity and in combination with their divergent intuitive and imaginative modes.

Another element which might provide insight into the creative process of these individuals is that of openness to change, or what was called in the previous Chapter, "the welcoming mind." Among all of the artists, William Morris appears to be the only one who did not consistently remain open to new ideas. Cezanne was remarkably receptive to the following generation of painters, Picasso consistently accepted new movements and innovations in art, even when they moved counter to his own work. Alberti was a conscious seeker of contemporary knowledge and change and certainly, he even made use of a great deal of the innovations of his time. Delacroix, for the most part, also exhibits a "welcoming mind," and accepted innovations in photography, color science, and other painting (notably the Pre-Raphealites) as greatly exciting and instructive, when many artists of his age rejected all three outright. Morris, however, hated modern civilization, and rejected almost entirely the Victorian notion of change and progress for their own sake. This tendency may be seen in a dual manner, as either a rejection of novelty and change entirely, or as a rejection simply of the change wrought by the industrial revolution. The Pre-Raphealite movement, which influenced Morris in his rejection of contemporary changes, was itself a revolutionary and novel stance in Victorian society. Morris was open to this change, as well as to political change and thus his rejection of the "progress" of industrializing England might be seen as a result of his definition of "progress," rather than an outright dislike of change itself. Morris did not like the quality of the "progress" he saw, and thus rejected it, not because it was new, but because it was harmful.

Of the five, Picasso, Morris and Cezanne were highly unconventional in their social behaviour. Alberti and Delacroix, on the surface, remain the picture of conventional respectability and no generalization can validly be made on this element of their character. No such limitation arises in the realm of play behaviour, and although both Picasso and Morris were highly active in this realm, Alberti and Delacroix seemingly less so, and Cezanne manifested it in a different way, all of them can be seen as highly playful at some level. Picasso and Morris were playful at both the active and symbolic levels, both consistently displaying boisterous, clowning and imaginative actions more usually associated with childhood, throughout their lives. At the symbolic or fantasy level, both were extremely active as well; Morris's fantasy finding most obvious example in his Romantic verse and Picasso's in his painting, poetry and, theatre design. Alberti and Delacroix were more highly active in play at the symbolic level. Alberti's mathematical games, inventions and cryptography, and Delacroix's romantic fascination and manipulation of exotic and fantasy-oriented subjects are examples of their involvement at that level. Cezanne, as well, manifests an involvement in the fantasy aspect of play behaviour, though it seems to fade with age, and many of his earlier paintings into which he injects himself as a figure in dream-like compositions, can be interpreted as imaginative play behaviour.

What commonalities as seem to exist in play behaviour are not by any means as forceful as those which exist in the area of emotional involvement in work. All of these artists placed a deep emotional investment in their work. It was for all of them, the primary focus and priority of their personal as well as professional lives. All were highly enthusiastic, energetic and able to bring to bear great emotional intensity on their creative endeavours. The deep love of art and Nature exhibited by all five artists was indeed the consuming emotional relationship in their lives, and the depth of emotional commitment was unmatched in their relationships with people.

Of the artists in this sample, only Alberti and Delacroix remained unmarried throughout their lives. Morris and Cezanne were both married once and Picasso appears to have been a "womanizer" in the true sense of that word. Thus, in the realm of personal relationships, one is confronted with no superficial common trend among these men. Their personal and private lives were in fact very different, and only one common trend emerges. All of them avoided as much as possible, personal conflict and none placed their emotional companions on a greater level of importance than their work. In fact, in each case but Picasso's, these men strove for harmony in their personal lives and avoided the distractions caused by them. Either by withdrawal and retreat, as in Cezanne, by amiable non-involvement, as in Morris, or by complete avoidance of intimacy as in Alberti and Delacroix, each relegated his personal affairs to a non-interfering secondary role in his life. Picasso tried as hard as he could to maintain emotional harmony in the personal realm, and though his personal affairs influenced the content of his work, they never in any sense superseded it. As emotionally chaotic as Picasso's relationships with others were, there is no doubt that he avoided personal conflict as much as he could, though his success in avoidance was small indeed.

Socially, there is no common trend that can be found among this group. And though all of them needed solitude to work, Alberti and Delacroix were quite conventional in their social tastes and maintained fairly regular attendance at social gatherings. Delacroix, of course became more solitary near the end of his life, but maintained the civilized veneer of a "gentleman" till his death. Morris was totally unconventional and contemptuous in social gatherings but maintained a fairly active circle of friends whose society and company he enjoyed. Picasso as well, appears as a highly social man, though totally unconventional and unimpressed by social demands outside his own circle of equally unconventional friends. Cezanne, was anti-social, and except for a few friends, and his family might have been a hermit. Thus, both in terms of the quantity and the nature of their social behaviour, the artist group seems to display no similarity at all.

None of the artists had respect for authority, and if they did not simply ignore it, as did Alberti, then they actively rebelled against it, as did Morris, Cezanne, Delacroix and Picasso. Their respect for and desire to succeed and gain acceptance, however, differed. Alberti was highly esteemed in his own time and did not need to concern himself with success or acceptance except in terms of his writings. In that case, he was hurt by criticism but did not change his style to accomodate it. Morris was basically unconcerned with acceptance or success, and ignored criticism entirely, Picasso, Delacroix, and Cezanne, all wanted success and acceptance, yet all refused to change or manipulate their work to gain it. So, in terms of the desire for success, these artists differ quite radically, but in their refusal to seek it through compromise of their work, they are strikingly similar.

Finally, in regarding the last of the points of reference for comparison, that is the social or political consciousness of the group, one finds a common tendency towards a "humanistic" ideal. Ideologically, at a very general level, their views are quite similar, all of them leaning towards freedom and equality, and non-violence. Their behaviour politically, or level of involvement in social issues is quite variant however, ranging from the passionate and active socialism of William Morris, to the theoretical humanism of Alberti. Delacroix, though protesting the loss of liberty in Greece and romanticizing the regained liberty of the French republic, was not basically political or even egalitarian in any sense beyond idealism, and in fact he may have been equally attracted to the romance and drama of those political subjects, as he was to their ideological importance. Picasso, though a Communist, was neither active politically nor Communist in his painting, and he can be viewed as either politically naive and idealistic or as simply a Communist man and Capitalist painter. Either way, he appears as neither highly active nor highly informed at the socio-political level. Cezanne maintained certain radical views, refused to be conscripted, and remained essentially uninvolved in politics or social issues. Thus, in this area, there would appear to be little commonality, except perhaps at the highly general ideological level.

Finally, Picasso, Alberti, Cezanne, Delacroix and Morris were all highly process-oriented, and all continued throughout their lives to actively inquire into their world. All were highly curious and remained so till their deaths. None saw their work as finished or finite, or as a separate series of products, but rather as a continuous search and expression of ideas throughout time. All re-explored and reworked similar ideas throughout their lives and none of them assumed the attainment of knowledge or growth were finite processes. And finally, all of these artists, Leon Battista Alberti, Eugene Delacroix, William Morris, Paul Cezanne, and Pablo Picasso, placed the exploration, the creation and the expression of the truth, beauty and reality of Nature at the centre of their adult lives, and kept it there throughout them.

CHAPTER SIX

THE COMMONALITIES

INTRODUCTION

This Chapter presents a summary of the common elements shared by both the artists and scientists explored in the previous two chapters. The common characteristics which arose in each group are examined here within the framework of the five broad points of reference which were used as starting points for inquiry and are presented in visual form in Figures 1 - 5. It must be stressed here that such commonalities as are displayed, and especially those charted, represent general tendencies and characteristics which arise in the world view, modes of thought, creativity, social interaction and social consciousness of the sample. They are by no means meant as a finite or exhaustive illumination of individual character. Each artist and scientist by nature of their individuality, is necessarily different from each other individual. The point here is not to disregard individuality, but rather to see if differences exist because of the individual's involvement in art or in science. This Chapter, then, presents evidence to suggest that there are as many if not more commonalities among these men, and that such differences as exist, and there are many, may just as easily be explained through individual personality differences as through an inherent dichotomy between the nature of their involvement in a discipline.

Thus, this Chapter presents an overview of shared commonalities in the areas of world view, modes of thought, creativity, social interaction and social consciousness, as they appear in the examination of the artists and scientists studied. It should be pointed out here that there are no clear or well-established boundaries between these five areas. The world view or philosophy of an individual necessary interacts with his modes of thought, as do both with his creative process, and so on. These areas are meant only as starting points and a good deal of overlap and inter-connection is inevitable. Thus, those aspects of thought and behaviour which appeared most relevant to each of the five elements, are those which are discussed in relation to them. Certainly, there are characteristics discussed under Creativity which could equally well be related under Modes of Thought, and it is important that the reader does not interpret these categories as exclusive or definitive. They serve merely as points of departure from which to explore the displayed commonalities between the artists and scientists under study.

WORLD VIEW; CONSCIOUSNESS OF REALITY

All members of both the artists and scientist's groups held a strikingly common vision of the world. They defined reality in a similar fashion, viewing Nature and the universe as harmonious, knowable, and possessed of an internal and unifying structure. As artists and scientists they placed the exploration and expression of Nature at the central core of their philosophies of their life works. Such an holistic view of Nature and knowledge as is displayed by these individuals is most striking when it is considered that all of them possessed at the same time, highly specialized knowledge, focussed on specific and relatively narrow aspects of Nature. None of them were, however, limited by the depth and complexity of their knowledge in one aspect of Nature, and it has been amply illustrated in previous chapters that their world views were broad, comprehensive and connective.

There exists, in addition, a common relationship between the individual himself, and Nature, or reality as he viewed it. All of the artists and scientists in the sample were actively, subjectively and deeply involved with the world. None were attracted to metaphysical or purely theoretical relationships with the world, but rather each, in his own way, established a deep and personal attachment to the world around them, recognized its beauty, delighted in its complexities, forms and structures, and viewed Nature and reality from within, as a part of it, through the senses as well as through the mind.

Another aspect of world view, that is, religion, shows some general similarities, but great diversity in its particular manifestations. The general common element shared between the artists and the scientists in relation to their expressed religious views, is that of an emphasis on individual rather than group involvement. None of the artists or scientists were highly committed to the organization of religion. Even Kepler, the most "church" oriented of the sample, refused to accept the entire church dogma. Thus, though most of the individuals might be called religious in their own manner, the common element among them is that each established a personal, non-traditional and unconventional or indifferent relationship to established religious authority. There, however, the similarity ends, and there is an equal tendency in both groups towards diversity ranging from atheism to passive indifference. Thus, in terms of a consistent attitude towards organized religion, there seems to be none. Except for the tendency in both artists and scientists, to remain aloof from the authority of the Church, their actual religious views were personal, individual and quite different.

Basic aspects of world view are summarized in Figure 1.

MODES OF THOUGHT

The most striking similarity between the artist group and the scientist group in the modes of thought utilized by both, may be described by the term SYNERGY. All members of both groups utilized both structured, linear and logical thought processes in addition to, and often in combination with, spontaneous, divergent and intuitive modes. Both intellectual and imaginative thinking was combined by both groups. In addition to the use of both, supposedly opposed, modes of thought, both groups were consistently integrative and connective in their thinking. All were highly skilled at relating new knowledge, ideas, insights, observations, and images to their overall matrix of thought and experience. In addition, all displayed an ability to relate and combine ideas, or images in a novel fashion, to perceive relationships which had previously been ignored or avoided.

All of the artists and scientists were able to work with structures, with order, and with a harmonious organization of elements, whether they were words, abstract symbols, actual objects, or images.

	ARTISTS					SCIENTISTS				
NATURE and REALITY viewed as as:	PABLO RUIZ PICASSO	PAUL CEZANNE	WILLIAM MORRIS	EUGENE DELACROIX	LEON BATTISTA ALBERTI	ALBERT EINSTEIN	NEILS BOHR	CHARLES DARWIN	HERMANN VON HELMHOLTZ	JOHANNES KEPLER
HOLISTIC	X	X	X	X	X	X	X	X	X	X
HARMONIOUS	X	X	X	X	X	X	X	X	X	X
ORDERED	X	X	X	X	X	X	X	X	X	X
KNOWABLE	X	X	X	X	X	X	X	X	X	X
UNKNOWABLE										
CHAOTIC										
GOD-CENTRED										X
NATURE-CENTRED	X	X	X	X	X	X	X	X	X	X
RELATIONSHIP OF SELF viewed as:										
ACTIVE	X	X	X	X	X	X	X	X	X	X
SUBJECTIVE	X	X	X	X	X	X	X	X	X	X
OBJECTIVE					X	X			X	
PASSIVE										
INVOLVED	X	X	X	X	X	X	X	X	X	X
UNINVOLVED										
PART OF NATURE	X	X	X	X	X	X	X	X	X	X
SEPARATE FROM NATURE										

FIGURE 1: WORLD VIEW: RELATIVE POSITIONS AND STANCES

All of them possessed and utilized highly active imaginations. Both groups displayed a great degree of intuitive insight into Nature as well as keenly developed observation skills. All men were concerned with the relationship between theory and practice, or intention and Nature. All integrated detail and whole and were capable of attaining a balance between them. None of these individuals worked exclusively in an inductive or deductive method, and all maintained a subjective, intuitive involvement with their work. All of these men possessed "welcoming" minds, made ready by active curiosity, consistent "search" experimentation, or observation, and open to recognize variant aspects of the world which could serve them in their endeavour. All of the artists and scientists in this sample were process-oriented, expanding and extending and changing their "products" thoughtout their lives. The emphasis for them was on "finding," "seeking," and continually attempting to move closer to Truth and Reality: the scientists so that they could explain it, and the artists so that they could express it. Both groups were, in addition, unafraid to take "risks" in thought, and were, for the most part, unhindered by the accepted thoughts and methods of their time. The unfettered nature of their thoughts, the "welcoming" aspects of their minds, and the integrative and connective characteristics of their mental abilities stand as the major commonalities between the artists and the scientists as "thinkers." The major characteristics of individual thought modes are presented in Figure 2.

GENERAL ASPECTS OR MODES OF THOUGHT:	ARTISTS					SCIENTISTS				
	PABLO RUIZ PICASSO	PAUL CEZANNE	WILLIAM MORRIS	EUGENE DELACROIX	LEON BATTISTA ALBERTI	ALBERT EINSTEIN	NEILS BOHR	CHARLES DARWIN	HERMANN VON HELMHOLTZ	JOHANNES KEPLER
EXCLUSIVELY LOGICAL										
EXCLUSIVELY INTUITIVE										
PROCESS-ORIENTED	X	X	X	X	X	X	X	X	X	X
PRODUCT-ORIENTED										
INQUIRY-ORIENTED	X	X	X	X	X	X	X	X	X	X
SUBJECTIVE	X	X	X	X	X	X	X	X	X	X
OBJECTIVE		X	X	X	X	X	X	X	X	X
THEORETICAL		X	X	X	X	X	X	X	X	X
PRACTICAL	X	X	X	X	X		X	X	X	X
INTEGRATIVE	X	X	X	X	X	X	X	X	X	X
DIVISIVE										
UTILIZATION OF INTUITIVE & LINEAR MODES	X	X	X	X	X	X	X	X	X	X

FIGURE 2: MODES OF THOUGHT: COMBINATION

CREATIVITY

The modes of thought mentioned above certainly may also be seen as aspects of the creativity of these artists and scientists. There are, however, other factors which might contribute to their "creative process" in which further commonalities are displayed. The common modes of thought which might best be seen as an aspect of their creativity, is the tendency towards combinative and synthetic thought. More importantly however, is the common trend towards perception which is at once more acute, and more attentive than that of most individuals. Both groups display a definite perceptual acuity, an ability to see similarities in seemingly different things, or to see matters in a novel and unconventional manner. The willingness to entertain combinations or juxtapositions which seem contradictory or unnatural, is also a common aspect of both groups. This is followed quite naturally by the total lack of concern, in the realm of work, for public opinion or support. All men in both groups, seemed quite unaffected by public criticism of their work, or by opinion which represented the traditions of their time. None were impressed by authority of any kind, and it would seem that the majority of both groups held strongly negative views on authority in general.

It may also be mentioned in regard to creativity that all of the artists and scientists displayed intense powers of concentration, and a high degree of patience, in relationship to their work. All of them were capable of prodigious work loads, long and arduous time commitments to their labour, and total focus of their intellectual, emotional

	ARTISTS					SCIENTISTS				
	PABLO RUIZ PICASSO	PAUL CEZANNE	WILLIAM MORRIS	EUGENE DELACROIX	LEON BATTISTA ALBERTI	ALBERT EINSTEIN	NEILS BOHR	CHARLES DARWIN	HERMANN VON HELMHOLTZ	JOHANNES KEPLER
SATURATION	X	X	X	X	X	X	X	X	X	X
COMBINATION	X	X	X	X	X	X	X	X	X	X
SYNTHESIS	X	X	X	X	X	X	X	X	X	X
PLAY	X	X	X	X	X	X	X	X	X	X
HIGH LEVELS OF CONCENTRATION	X	X	X	X	X	X	X	X	X	X
OPEN TO UNCONVENTIONAL CONCEPTS	X	X	X	X	X	X	X	X	X	X
SOLITUDE FOR WORK	X	X	X	X	X	X	X	X	X	X

FIGURE 3: CREATIVITY: CHARACTERISTICS

and physical energies on the work at hand. All members of both groups, though able to focus concentration to intense degrees were at the same time acutely aware of small, often distracting details which might have relevance to their work. All had a capacity to make use, mostly positive use, of accidents of thought and action, and though most were "saturated" mentally and emotionally with their work, they seemed capable of maintaing a variety of thoughts and ideas at the same time.

A final common element which may have some bearing on the creative processes of both groups, is the relatively consistent occurrence of play behaviour. Though there is no common category or type of play behaviour which arises, all of the artists and scientists under study manifested this type of behaviour at either the active, or the symbolic level. There was an equal tendency towards both types of play exhibited within both groups, and neither shows a tendency to rely exclusively on one or the other types. Some aspects of Creativity are represented in Fugure 3.

SOCIAL INTERACTION

In the area of social interaction, one tends to find more differences than similarities between individuals. This is certainly true of both groups, though the differences seem to be between individuals rather than between groups. All of the artists and scientists displayed diverse social behaviours, personal relationships and responses to social conventions. Both groups had members who were highly social, convivial and enjoyed social gatherings. Both groups had members who were, if not anti-social, at least contemptuous of society with a capital 'S'. Both groups had members who were high unconventional in social behaviour as well as members who quite accepted the social proprieties of their day. Both groups had members who maintained personal relationships ranging from stable to disastrous, from calm and permanent to tumultuous and erratic, and there is little if any internal group consistency in this realm. There are, in fact, a few social attitudes and behaviours, and few personal relationships, which are not represented by the individuals in each group.

In the face of such individual diversity, however two factors, common to both groups and all the individuals within them, are outstanding. Both groups, the artists and the scientists, irregardless of their social life styles, their personal relationships, or their lack of both, in the realm of interactions with people placed their work first, foremost and in absolute supremacy. The centrality of work, as compared to the importance of people, arises over and over again in the social and personal lives of these individuals. In point of fact, it most probably accounts for the various social and personal behaviours.

All of these individuals sought for harmony in their personal, and emotional lives, most definitely to avoid distractions which would hinder their work. Whether such harmony was attained through a stable, consistent non-demanding marriage, through acceptance of

	ARTISTS					SCIENTISTS				
	PABLO RUIZ PICASSO	PAUL CEZANNE	WILLIAM MORRIS	EUGENE DELACROIX	LEON BATTISTA ALBERTI	ALBERT EINSTEIN	NEILS BOHR	CHARLES DARWIN	HERMANN VON HELMHOLTZ	JOHANNES KEPLER
RELATIONSHIPS SECONDARY TO WORK	X	X	X	X	X	X	X	X	X	X
FOCUS ON STABILITY & HARMONY	X	X	X	X	X	X	X	X	X	X
AVOIDANCE OF EMOTIONAL CONFLICT	X	X	X	X	X	X	X	X	X	X
CENTRALITY OF WORK	X	X	X	X	X	X	X	X	X	X
UNCONVENTIONAL	X	X	X			X				X
CONVENTIONAL BEHAVIOUR				X	X		X	X	X	
ANTI SOCIAL		X								X
SOCIAL WITH FRIENDS	X		X	X	X	X	X	X	X	
DEVIATION FROM SOCIAL NORMS	X	X	X			X				X
CONVENTIONAL IN SOCIAL SITUATIONS				X	X		X	X	X	
LASTING PERSONAL COMMITTMENTS		X	X				X	X	X	

FIGURE 4: SOCIAL INTERACTION

social convention, or through avoidance and rejection of both, both groups needed, sought and established that harmony and stability. This brings into focus the second and only other commonality shared by these men in the social and personal realm. All of them consistently avoided emotional conflict. This is not to say that none of them experienced any, and in fact some of them, in both groups, were plagued by such personal conflicts on many occasions. All of them, however, definitely made strong efforts to endure as little emotional conflict as was possible. Without doubt, as different as they are in this area, all of the artists and scientists were far more concerned with things and ideas than with people. Major elements of social and personal behaviour are summarized in Figure 4.

SOCIAL AND POLITICAL CONSCIOUSNESS

Once again, in the area of social and political consciousness, the differences between the individuals are greater than those between the groups. It may be mentioned again here, that the tendency to reject authority was consistently displayed by all individuals in both groups. Aside from that aspect however, it would appear at first glance that very little commonality exists even within the groups. In terms of involvement in social affairs or political issues, both groups have members who are passive and both have members who were highly active. Ideologically, one might find a general tendency towards belief in in freedom and equality, even though the manifestations of that belief range from radical Socialism, to Communism, to total non-involvement. Certainly, based on their actions, there is little consistency even within the individuals themselves. Their political responses where they exist, are almost always idealistic, emotionally-based and ideological, and one does find a general consistency between groups on an ideological level. A distaste for war, violence, and force of any kind, an internationalist leaning, a dislike for prejudice, racism and mistreatment of minorities, and a love of freedom and equality for all, seem to be commonly shared by members of both groups. One must question however, not the sincerity, but the maturity and depth of such a general "liberal" stance. For throughout both groups, inconsistencies arise within the individuals themselves, and one is confronted with Einstein's pacifism beside his encouragement of the use of nuclear weapons; and with Picasso's outrage at "Guernica" and seeming indifference to the world wars which wracked France.

There seems in the realm of actual involvement, a tendency towards political immaturity and naivety in most of the individuals explored, but essentially, they remain individual in their political and social involvements. Thus, though a very general commonality in ideology exists, between both groups, and a definite common reaction against authority, the behaviour and the responses of each individual, whether artist or scientist, must be viewed as different, if not in essence, certainly in act. Figure 5 presents the general characteristics of the social and political consciousness of both groups.

	ARTISTS					SCIENTISTS				
	PABLO RUIZ PICASSO	PAUL CEZANNE	WILLIAM MORRIS	EUGENE DELACROIX	LEON BATTISTA ALBERTI	ALBERT EINSTEIN	NEILS BOHR	CHARLES DARWIN	HERMANN VON HELMHOLTZ	JOHANNES KEPLER
ACTIVE INVOLVEMENT	X		X			X	X			
PASSIVE INVOLVEMENT		X		X	X			X	X	X
EMOTIONAL	X	X	X				X			X
INTELLECTUAL				X	X	X		X	X	
HUMANISTIC	X	X	X	X	X	X	X	X	X	X
NON-VIOLENT	X	X	X	X	X	X	X	X	X	X
ANTI-AUTHORITARIAN	X	X	X	X	X	X	X	X	X	X
AUTHORITARIAN										
APOLITICAL		X			X				X	X

FIGURE 5: SOCIAL AND POLITICAL CONSCIOUSNESS

CHAPTER SEVEN

TOWARDS AN HEURISTIC VIEW OF ART AND SCIENCE

This Chapter presents a summary of the findings, the conclusions which may be drawn from them, and the implications which arise having relevance for our cultural understanding of Art and Science. Since the educational manifestations of the traditional view of Art and Science are highly influential in the maintenance of cultural stereotypes, some consequences of potential Art-Science commonalities as they reflect on educational practice are also discussed here. In addition, this Chapter outlines recommendations for further research and inquiry which might deepen our knowledge and insight into Art-Science relationships and consequent epistemic and educational assumptions.

RESTATEMENT OF THE PROBLEM

This study set out to illuminate significant commonalities in creative artists and scientists in an attempt to contribute to a less polarized and restrictive view of Art and Science. Through such an investigation of representative individuals, it was hoped to provide qualitative evidence that the traditional Art-Science dichotomy provides not only a limited and fragmented view of knowledge, but that it presents actual obstacles to a clear and basic understanding of two of the greatest products of human creativity.

The specific purposes of the study were stated as follows.

a) to discover and delineate possible characteristics of behaviour and thinking style in creative Artists and Scientists.

b) to select, and synthesize these common elements where they exist into a synergetic and heuristic view of the artist and scientist which might provide a basis for more comprehensive, less stereotyped insight into the fields of Art and Science.

c) to examine the implications of such commonalities as are discovered for the traditionally assumed dichotomy between Art and Science and its dominant educational manifestations.

In addressing itself to these purposes, this study examined a sample of five highly creative artists, and five highly creative scientists, drawn from different historical periods and various fields of specialization within the two broad fields of Visual Arts and Science. Each individual was described morphogenically; within-group commonalities were delineated, and between group comparisons were undertaken in the areas of world view, modes of thought, creativity, social interaction and social or political consciousness.

SUMMARY OF FINDINGS

Striking commonalities between the Artists and Scientists samples were found in three of the five areas examined, and the differences found in the remaining two, displayed no group cohesion, but only individual variance across both groups. These commonalities and differences are delineated in the preceding Chapter and need not be repeated in detail here. However, it may be helpful to review the major tendencies which were displayed by both the Artist and Scientist group, and which contribute to an emerging view of the "Artist" or "Scientist," quite varient to the cultural archetypes held in conventional wisdom.

Primarily, all of the Artists and Scientists described viewed the world in a similar fashion, all were conscious of an harmonious, ordered, integrated reality, all were Nature-centred, holistic, and structure-seeking. None were highly committed to organized religion, most avoided metaphysical speculation and to some extent all of them avoided highly specialized or tightly classified views of reality.

All of the members of both groups combined varying modes of thought, utilizing both structured, formal modes, and intuitive, imaginative modes. All were synthetic in their thinking, able to combine and integrate various ideas in different ways, and all were able to maintain intense concentration or focus when working. None were hindered by traditional sets, or authority, and neither were any afraid of error, risk, novelty, or criticism. All were highly and emotionally involved with their work, to the extent that, in all cases, it gained priority over personal involvements.

In the personal, social and political realms, there was a high degree of variance from individual to individual. No significant group commonalities or group differences were displayed except in the area of avoidance of emotional conflict and centrality of work.

CONCLUSIONS

There is no doubt that strong commonalities exist between highly creative artists and scientists as they are represented in this study. It would seem, in fact, that more similarity than difference is displayed among these two groups, differences being of an individual rather than group nature. Though one hesitates to generalize from such a small sampling to the larger population of all highly creative artists and scientists, there do exist certain conclusions that can be made from the findings as they stand.

The first, and perhaps most justifiable, conclusion that can be advanced, is that the cultural archetypes of Artist and Scientist are highly limited. Such stereotypes can hold little currency in the face of any exceptions. The stereotype of the purely logical, objective, impersonal Scientist, is clearly contradicted by Kepler, Von Helmholtz, Darwin, Bohr and Einstein. In addition, a glance at Alberti, Delacroix, and Morris, contradicts the archetypical view of Artist, as non-thinking, purely emotional and Bohemian. Such stereotypes, not only over-simplify, over-generalize and obscure individuality, but also introduce serious obstacles to understanding individuals and the processes by which they work. In attempting to avoid ambiguity, stereotypical definitions classify and fragment our understanding of reality and inevitably mislead; imposing general categorizations and definitions based on difference, inhibiting a connective, holistic view of the person and of the world. The commonalities displayed by the artists and scientists examined in this study, if nothing else, suggest the falsity of the cultural stereotypes so readily accepted by conventional wisdom.

Certainly, if it has been indicated that one highly classified, exclusive stereotypic definition of the Artist or Scientist is limited and misleading, one may assume that any tightly articulated definition would provide similar limitations to understanding. It remains to be seen whether any descriptive definition of an individual or a group can avoid the restrictions of over generalization on the one extreme or ambiguity on the other. However, since the traditional stereotypes remain inadequate, some alternative framework within which to view the Artist and the Scientist would seem advantageous, even if it serves only an heuristic purpose. From the basis of commonalities discovered between the two groups examined in this study, certain characteristics belonging to both the highly creative Artist and the highly creative Scientist, may serve as guidelines for an alternative view to the traditional cultural stereotypes.

The foundation of an alternative and heuristic view of the Artist and the Scientist emerges when their world view or consciousness of reality is examined. Contrary to the popularistic assumption that the Scientist views the world differently than does the Artist, one finds at the base of their world view, the common tendency to define reality as holistic, harmonious, dynamic and inter-related. To this shared defining factor must be added the common tendency to highly emotional involvement in their explorations of the world, and deep subjective committment to work. In addition, the connective and integrative characteristic of thought, the openness to novelty and the basic lack of respect for authority, emerge as further contributions to an alternative view of the Artist or Scientist. It is no longer possible, in the face of evidence concerning the creative processes of the two groups, to exclusively define the Scientist as the logical, rational, purely objective thinker, and the Artist as the intuitive, purely emotional creature of conventional wisdom. Rather, it seems that the highly creative Artist and Scientist, as represented here, utilize both highly intuitive and highly formal and structured modes of thought within their work. It would appear that if a new definitional framework is to be derived for either group, the "either-or" classification must be discarded. The scientists represented here were neither exclusively logical, purely objective, nor completely linear in their approach to their work. Similarly, the artists represented here were not exclusively intuitive, subjective and divergent. Rather, both groups seemed to display a tendency towards complementary, dynamically inter-related utilization of both approaches to their work.

In contrast to the traditionally dichotomous stereotype describing the artist and the scientist as representative of the emotional as versus the intellectual aspects of human nature, the emerging view suggests rather, that it is the dynamic interaction and complementarity of both extremes, which is more characteristic. This emerging picture detracts nothing from the highly developed knowledge and expertise of either group, and by no means implies that one might define Artists and Scientists as identical. It does, however, avoid the restrictions inherent within elite and exclusive definitions which, due to their closure, inhibit understanding and interaction. There can be little communication and even less joint problem-solving between individuals or groups who can identify no common ground. The traditional stereotypic view of Artist and Scientist has inhibited understanding and communication between two of the most highly creative groups within society and continued acceptance and perpetration of such a stereotype, aside from encouraging misconceived assumptions, will increase the fragmentation within a society which could only benefit from interaction.

As a consequence of these commonalities shared by individuals highly involved in both fields, the traditional dichotomy between Art and science comes under serious question. The traditional polarization of Art and Science assumes intrinsically different and opposing processes and products operating in the two fields. Though this study cannot generalize to the products of Art and Science, in examining the processes which produce both, in the individual "producer," it does suggest less difference and opposition than is traditionally assumed. Certainly, one does not find the radical differences that polarity suggests, but rather a complementarity, or integration of process, character and creative behaviour that implies great similarity between the two fields. It must be stressed here, that similarity does not imply identity, and no attempt is being made to claim identity between the two fields. Rather, the conclusions drawn suggest simply that strong relationships exist, both between the individuals who work in

Art and Science, and between the processes they employ within that work. Any traditional assumptions which do not take such relationships into account, are necessarily too narrow, restrictive, and simplistic, to provide any real insight into the processes of either Art or Science. Thus, the traditional Art-Science dichotomy, may now be seen as a highly limited view of the two fields, and their assumed modes of knowing the world. It appears as too limited a framework on which to base either personal or professional judgements regarding the nature of Art or Science, and certainly it remains an unworthy basis for judgements concerning the educational aspects of either field.

IMPLICATIONS FOR EDUCATION: THE SLAYING OF THE MYTH

It would certainly appear that there exist strong implications for education arising from the commonalities which have been outlined in this study. Nowhere does the traditional dichotomy between Art and Science, and the mythic stereotypes which arise from it exhibit its influence more strongly than in our educational institutions. Both public schools and post-secondary institutions are guilty of obscuring integrated comprehension of both endeavours in a haze of specialization. Relationships between Art and Science are not only left unexposed, but may actually be obscured by the growing tendency to "close ranks" in specialized disciplines and to stress narrow expertise rather than generalization in teacher education. The content or subject matter of disciplines has always held priority in education, and even in face of recent emphasis on processes and skills, there seems little attempt in schools to relate either subject matter or process in Art and Science. The commonalities displayed in artistic and scientific world view, modes of thought and creative process, suggest that the current fragmentation in education should be decreased by a greater emphasis on relating and integrating Art and Science learning.

Though there may exist little similarity between the products of artistic thought and those of scientific thought, the processes, methods, and development of thought in both fields are strikingly similar. A greater stress in both Art and Science education on processes and methods, as they are displayed by artists and scientists, would not only point out inherent commonality and relationship, but would refocus the emphasis on both fields as developing human endeavours. Certainly, in post-secondary institutions, and especially in universities greater stress should be placed on relating, combining and connecting knowledge. There can be no doubt that a more holistic, integrated and less dichotomized view of knowledge in general, and of Art and Science in particular, would be a positive and necessary step towards a fuller comprehension of the world. There is no doubt that at a time when education is becoming progressively more specialized, more fragmented and more highly classified, there is a real need to insure that unifying concepts, relationships and common aspects of knowledge are not overlooked.

Perhaps even more important for education, is the implication that knowledge is gained by more than one mode of thought or one method of inquiry. Certainly the Western tendency in education to place greatest emphasis on reason and structured logic as the exclusive mode of gaining knowledge must be re-examined in the light of the artists and scientists explored in this study. It would appear that some of the greatest contributions to Western knowledge were made by individuals who utilized intuition as well as intellect, emotion as well as discipline and imagination as well as reason. Such complementarity is not a marked characteristic of our educational systems, and certainly a more balanced, less dichotomous approach to human knowledge creation would be a vast improvement in schools.

To maintain and encourage the traditional polarization of Art and Science within an educational framework, will serve only to distort, misrepresent and obscure common aspects which exist between both fields, their processes, and the individuals who create them.

Finally, research directed towards investigating the epistemelogical foundations of our educational institutions is needed. Such research must inquire into the relationships between various modes of knowing and the educational consequences of a more synergic view of knowledge.

> It is probably true quite generally that in the history of human thinking the most fruitful developments frequently take place at those points where two different lines of thought meet. These lines may have their roots in quite different parts of human culture, in different times or different cultural environments or different religious traditions: hence if they actually meet, that is, if they are at least so much related to each other than a real interaction can take place, then one may hope that new and interesting developments may follow.
> (Heisenberg, 1963, pg. 187)

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For the purpose of simplicity the bibliography has been divided into three sections:

1) Art-Related Works -- dealing with Art, Artists, Art History, Aesthetics and Art Education.
2) Science-Related Works -- dealing with Science, Scientists, the History and the Philosophy of Science.
3) General Works -- dealing with Art-Science Relationships, Philosophy and Psychology.

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APPENDIX A

Johannes Kepler: 1571-1630

1571 - born in Weil, Swabia, Dec. 27.

1589 - went to University in Tubingen

1594 - went to Graz to take position as mathematics professor at Protestant seminary

1595 - inspiration on which "Mysterium" was based

1597 - "Mysterium Cosmigraphicum" finished and published
- marriage April 27

1600 - expelled from Graz for religious non-conformity
- worked with Tycho de Brahe until his death in 1601
- became Imperial Mathematician in Prague

1605 - work completed on "Astronomia Nova"

1609 - "Astronomia Nova" published
- work in progress on Rudolphine Tables

1611 - Kepler's son dies, family ill, wife dies
- Kepler gets position in Linz

1612 - moves to Linz as District Mathematician

1613 - Kepler marries again

1619 - "Harmonice Mundi" completed

1626 - move to Ulm

1627 - "Rudolphine Tables" completed

1629 - work on "Somnium"

1630 - died, in Regensburg, November 15

Hermann von Helmholtz: 1821-1894

1821 - born Aug. 31, Potsdam

1834 - medical student in Berlin

1842 - graduation and first position as surgeon

1843-48 - Army Surgeon at Potsdam

1847 - "On the Conservation of Energy"

1848 - lecturer at Academy of Arts in Anatomy in Berlin

1849 - Professor of Physiology at Konigsberg; marriage

1850 - discovery of opthalmascope

1852-55 - work on optics, colour, light, acoustics

1855 - Professor of Physiology and Anatomy at Bonn

1858 - Professof of Physiology at Heidelberg

1859 - death of first wife

1861 - remarriage; work on Conservation of Force

1862-71 - work on music, tone, optics, vision, acoustics, dynamics of fuilds, electricity and Electrodynamics

1871-1888 - Professor of Physics in Berlin; worked on Electrodynamics, fluids, meteorology, magnetism, optics, thermodynamics of chemical processes, mathematics

1888-94 - President of Imperial Physico-Technical Institute at Charlottenburg; work on vision, atmosphere, color, electrodynamics

1894 - death, Sept. 8 in Charlottenburg

Charles Darwin: 1809-1882

1809 - born at Shrewsbury, England

1825 - matriculated in the University of Edinburgh

1831 - B.A. degree from Christ's College, Cambridge
- sailed on "Beagle," on 27 Dec.

1836 - returned to England after journey to Galapagos, South America, etc.

1839 - married Emma Wedgewood
- "Journal of Researches" (Beagle) published

1842 - wrote Sketch of Species Theory; "Structure and Distribution of Coral Reefs" published

1846 - began work on barnacles

1856 - began large work on species

1858 - joint paper on evolution with Wallace, published

1859 - "Origin of Species" published

1862 - work on orchids published

1868 - "Variation of Animals and Plants Under Domestication" published

1871 - "Descent of Man" published

1882 - died, April 19, at Down House

Niels Bohr: 1885-1962

1885 - born Oct. 7 in Copenhagen

1903 - began studying physics at University of Copenhagen

1909 - Masters Degree

1911 - Doctor's thesis on the electron theory of metals
- goes to England to do research with J.J. Thompson at Cambridge

1912 - research with Ernest Rutherford in Manchester
- marries on Aug. 1st

1913 - theory of Atomic Constitution and Spectra

1914 - lecturer at University of Manchester

1916 - Professor of Theoretical Physics at University of Copenhagen

1921 - inauguration of University Institute for Theoretical Physics

1922 - theory of the periodic system
- Nobel Prize in physics

1927 - analysis of the problem of observations in atomic physics, theory of complementarity

1936 - the liquid drop model of the atomic nucleus

1943 - escape to Sweden

1943-45 - attached to British American atomic energy project

1945 - return to Denmark

1950 - open letter to United Nations

1955 - Chairman of the Danish Atomic Energy Commission

1962 - dies, Nov. 18 at Carlsberg

Albert Einstein: 1879-1955

1879 - born at Ulm, Bavaria

1880-94 - in Munich to attend Gymnasium

1894 - moved to Italy

1896-1901 - studied in Switzerland

1901 - married, worked in Patent Office in Bern

1905 - papers on Quantum Theory, Relativity and Brownian Motion;
lectured at Bern University

1909 - Associate Professor at University of Zurich

1910 - Professor of Theoretical Physics at University of Prague

1913 - moved to Berlin; member of Prussian Academy

1916 - work on General Relativity finished; second marriage

1919 - confirmation of General Relativity Theory

1919-32 - visits U.S.A., England, France, Japan, Spain, China, Palestine;
received Nobel prize for theory on photoelectric effect (1922)

1933 - resigned Prussian Academy; became Professor at the Institute for
Advanced Study, Princeton, N.J.

1945 - official retirement

1949 - announced generalized theory of gravitation

1955 - death

APPENDIX B

Leon Battista Alberti: 1404-1472

1404 - born in Genoa

1421 - left Gymnasium in Padua
- attended University of Bologna in law

1428 - studies in law and literature and matnematics completed; received doctorate in Canon Law

1428-32 - Secretary to Bishop of Bologna

1432-40's - "della Familia" and other humanist writings

1432 - went to Rome to work in papal chancery as secretary

1434 - moved to Florence; began to paint and sculpt

1435 - "della Pittura"; "della Statua"

1450 - Tempio Malatestiano

1452 - "de re aedificatoria"; Ludi Mathematica

1455-60 - Santa Maria Novella, Florence; Pallazzo Rucellai

1464 - dismissed from papal chancery

1466 - work on coding

1470 - church at Sant' Andrea in Mantua

1472 - death, in Florence

Eugene Delacroix: 1798-1863

1798 - born, April 26, at Charenton-St. Maurice

1815 - entered studio of Geurin in Paris

1816 - entered L'Ecole des Beaux-Arts

1819 - Gericault's "Raft of the Medusa" exhibited at Salon

1822 - began "Journal," Sept. 3rd.
- exhibited "Barque de Dante" at Salon

1824 - "Massacre at Chios" at Salon; "Journal" stops

1825 - trip to England

1827 - "Death of Sardanapalus" provoked strong opposition

1830 - July Revolution

1831 - "Liberty Leading the People" at Salon

1832 - Journey to Morocco and Algiers

1834 - "Women of Algiers"; wall murals in progress at Palais Bourbon

1838 - received commission for decorations at Library of the Chambres des Deputes

1839 - trip to Holland

1846 - Delacroix created officer of Legion d'Honneur

1847 - resumes "Journal" which he continues till death

1849 - begins decorations in Chapel, St. Sulpice; "Jacob Wrestling with the Angel" etc. completed 1861

1855 - exhibits thirty-five paintings in retrospective at L'Exposition Universelle, Paris

1857 - elected to the Institute on eighth application

1863 - died, Aug.13, Paris

William Morris: 1834-1896

1834 - Morris born, March 24, Walthamston, England

1853 - goes to Oxford, stays till 1856

1856 - moves to London with Burne-Jones, meets Rosetti, decides to paint

1859 - marries Jane Burden

1861 - firm of Morris, Marshall, Faulkner & Co. founded

1868 - "Earthly Paradise" published

1871 - takes Kelmscott Manor - visits Iceland

1875 - Morris, Marshall, Faulkner and Co. dissolves and Morris and Co. set up
- begins dyeing experiments

1877 - Morris's first lecture "The Decorative Arts"

1878 - Begins tapestry weaving, active in Society for Protection of Ancient Buildings

1884 - becomes involved with Socialism

1885 - formation of Socialist League

1891 - Kelmscott Press founded

1896 - William Morris dies, October 3rd, buried at Kelmscott, Oct. 6.

Paul Cezanne: 1839-1906

1839 - born Jan. 19, at Aix-en-Provence

1852-58 - Cezanne at College Bourbon, Aix

1858 - Emile Zola leaves Aix for Paris

1861 - Cezanne's first trip to Paris

1862 - employed in Aix Bank, returned to Paris to paint

1863 - Salon des Refuses

1870 - Franco-Prussian War; Cezanne in L'Estaque

1872 - Cezanne's son born in Paris to Hortense Fiquet
- goes to Auvers-sur-Oise, works with Pissarro

1874 - First Impressionist Exhibition

1882 - portrait by Cezanne hung at Salon

1886 - marriage to Hortense Fiquet, break with Zola, death of Cezanne's father, Louis-Auguste

1889 - painting by Cezanne hung at L'Exposition Universelle

1890 - exhibits in Brussels with Les Vignt

1901 - two paintings at Salon des Independants

1905 - ten paintings at Salon d'Automne

1906 - death of Cezanne, Oct. 23, at Aix

Pablo Ruiz Picasso: 1881-1973

1881 - born, October 25, Malaga, Spain

1897 - student at Royal Academy of San Fernando in Madrid

1900 - first trip to Paris

1904 - first exhibition at Vollard's in Paris; early Blue Period; moves to Paris

1905 - meets Fernande Olivier; beginning of Rose Period

1907 - paints Les Desmoiselles d'Avignon; meets Braque; beginning of Cubist explorations

1913 - begins Synthetic Cubist period

1917 - goes to Rome with Jean Cocteau; designs sets for "Parade"

1918 - marries Olga

1921 - birth of son Paul; two versions of Cubist "Three Musicians"
- continues classical period

1930 - moves to Chateau de Boisgeloup

1935 - birth of daughter Maia to Marie-Therese Walter

1937 - paints "Guernica"

1939 - outbreak of World War II; large retrospective exhibition in Museum of Modern Art, New York

1941 - writes play "Desire caught by the Tail"

1946 - meets Francoise; continues lithography

1947 - begins ceramic work at Vallauris

1955 - moves to La Californie, Cannes

1961 - marries Jaqueline Roque

1973 - dies, April 8, in Mougins